THE PLANT DISEASE REPORTER

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Division of Mycology and Disease Survey

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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FORECASTING THE OCCURRENCE OF DISEASES AND INSECTS IN JAPAN[1]

Samuel C. Salmon[2]

Forecasts, predictions, or warnings of possible losses from diseases and insect pests, as a means of stimulating control measures, have been issued in Japan for about 10 years. These predictions are based on research extending back as long as 50 years in some cases but for only a few years in others. Fairly reliable predictions of date of attack and a rough estimate of the probable degree of damage can be made for rice stem borer (Chilo simplex (Butler)) and neck blast (Piricularia oryzae Br. & Cav.) of rice. Such predictions, especially for neck blast, are subject to weather conditions subsequent to the forecast. In other cases no more than a warning that losses are possible or probable are justified by the experimental data currently available. The diseases and insects on which research relating to forecasts is now under way include rice blast (Piricularia oryzae Br. & Cav.); seedling rot of rice (Achlya spp., Pythium oryzae Ito & Tokunaga [P. dissotocum Drechsler], etc.); stem rust of wheat and barley (Puccinia graminis Pers.); stripe rust of wheat and barley (Puccinia glumarum (Schm.) Eriks. & E. Henn.); leaf rust of wheat (Puccinia triticina Eriks.) [P. rubigo-vera tritici (Eriks. & E. Henn.) Carl.]; leaf rust of barley (Puccinia simplex Eriks. & E. Henn.) [P. hordei Otth.]; powdery mildew of wheat and barley (Erysiphe graminis DC.); scab of wheat and barley (Gibberella saubinetii (Mont.) Sacc.) [G. zeae (Schw.) Petch]; late blight of potatoes (Phytophthora infestans (Mont.) De Bary); paddy borer (Schoenobius incertulas (Walker)); stem rice borer (Chilo simplex (Butler)); rice hoppers (Liburnia furcifera (Horvath), Nilaparvata lugens (Stal), Delphacodes striatella (Fallen); and Nephotettix bipunctatus cinticeps (Uhler)); rice skippers (Parnara guttata Bremer & Gray); rice leaf beetle (Lema oryzae Kuwayama); and rice leaf miner (Agromyza oryzella Matsumura). Individual Prefectures also conduct research and issue forecasts or warnings regarding crane fly of rice, wheat, and barley (Tipula aino Alexander), rice stem maggot (Chlorops oryzae Matsumura), potato lady beetle (large 28-spotted)(Epilachna nipponica Lewis), and various vegetable pests.

Data that are collected, methods of collection, and methods of making forecasts or predictions vary, of course, with different pests. In general they include meteorological data, especially temperature, rainfall, and sunshine (for certain pests), development of the crop including in appropriate cases the height of the plants, number of leaves and tillers, and dates of heading and ripening. Observations on the pests include over-wintering (in appropriate cases), possible sources of infection or infestation, prevalence at various dates of spores or other means of infection by diseases, dates of emergence, and prevalence of insects. For important pests, observations may be made at several points in each Prefecture and at different times of the year. The data are compared with those of previous years including the average or normal for all years. First appearance and prevalence of the pests are correlated with weather conditions and development of the crop so far as possible. Tabular data are supplemented by general observations during field trips over each Prefecture at appropriate seasons. Reports on forms provided by the National Government are sent to the Prefectural Stations and to the Agricultural Improvement Bureau of the Ministry of Agriculture and Forestry every 10 days, at the end of each month, and at the end of the year. Unusual outbreaks or special situations that may materially affect the occurrence of diseases or insect pests may be reported by telegraph. The reports also include floods, storms, snow, late frosts and and other conditions that may have a bearing on the interpretation of the results.

Insect Forecasts

Rice Stem Borer (Chilo simplex (Butler)): -- Investigations of the dates of emergence and prevalence of rice stem borer and their relation to weather conditions have been under way since about 1900. Collection of basic data is relatively easy since the moths are readily attracted by

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[1]All information contained in this article was supplied by officials of the Agricultural Improvement Bureau, Ministry of Agriculture and Forestry, Japanese Government, Tokyo, Japan. This paper was initiated as part of a project by Natural Resources Section, General Headquarters Supreme Commander for the Allied Powers, for the purpose of increasing the effectiveness of crop insect and disease control programs in Japan. The author was Head of the Research and Extension Branch of the Agriculture Division, Natural Resources Section, from March 1950 to January 1951. Published by permission of the Chief, Natural Resources Section.

[2]Principal Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.

lights. Daily records of numbers of moths collected at strategic points have been an important feature of these studies. Several mathematical formulae have been devised which take into account the number of moths, time of emergence, temperature, and other meteorological conditions. Dates of first emergence or of maximum emergence are desired so that appropriate measures for control can be put into effect. These formulae vary somewhat for different Prefectures and with respect to the particular factor on which prediction is based. Usually they are based on mean temperatures for a particular month, March, April or May, but in one case at least on April precipitation. One is used in Gumma Prefecture in which prediction is based on the mean March temperature and date of blooming of cherry blossoms. This latter formula is:

$y = 23.3 - 0.537x + 0.457z$, in which
y = predicted date of maximum emergence plus or minus May 31
x = mean temperature for March
z = date of first blooming of cherry blossoms.

In this case the maximum deviation of the actual from the predicted date in any year has been 4.6 days, and the average deviation 2.0 days.

Current research includes a determination of the number of moths attracted by a 60 watt double filament frosted bulb renewed every two to three months to insure a constant radiance. Equipment to insure constant voltage is also used. The bulbs are placed at strategic points not likely to be influenced by nearby straw stacks or rice nursery beds. The same type of bulb is used at all locations and changes in type of bulb are avoided so far as possible. Data include the numbers of male and female moths collected each day, the date of first emergence, period of most intense emergence, last date of emergence, and the ratio of catch of the first generation to that of the second generation, insofar as the two generations can be distinguished. Observations extend from April 1 to October 31 and cover all of Japan. Variations from the normal period of transplanting rice and the date of heading are considered very important.

The above records are supplemented with surveys of overwintering of larvae in straw stacks and stubble, methods of stacking straw, the transplanting period, the harvesting period and height of remaining stubble, treatment, if any, of stubble land, prevalence of winter crops, the actual infestation in representative fields in each Prefecture, varieties of rice grown, methods of growing rice, and the relation of these to overwintering.

These data are correlated with collections from light traps in order to confirm or improve predictions of forecasts based on the latter.

Rice Leaf Hoppers: -- Forecasts and warnings of probable damage from rice leaf hoppers have been issued since 1941 on the basis of research conducted since 1900.

The data recorded are similar to those for rice stem borer and the same equipment is used for collecting the adult hoppers. Collections are segregated according to kind, including the white back plant hopper (Liburnia furcifera (Horvath)), brown plant hopper (Nilaparvata lugens (Stal)), smaller brown plant hopper (Delphacodes striatella (Fallen)), green rice leaf hopper (Nephotettix bipunctatus cincticeps (Uhler)), and others prevailing in the locality. Since predictions based on collections at lights have not been fully satisfactory, surveys to determine population densities in various situations are considered especially desirable. These make use of sweeping with a net for adults, brushing down of rice hills for both adults and nymphs, and determinations of the number of eggs laid per hill. Eggs laid on barnyard grass growing in the rice also are included. Mass emergence in local areas especially in the fall may require special attention.

Methods of predicting the occurrence of leaf hoppers have not been fully worked out, though for western Honshu it has been found that their prevalence in Kyushu is a very reliable index. Since infestation in Kyushu occurs about a month earlier than in Honshu there is ample time for assembling and interpreting data and getting out warnings.

Other Insects: -- Studies relating to forecasts or warnings for other insects follow much the same pattern as for rice stem borer or rice leaf hoppers.

Research relating to paddy borers has been under way since 1927. Since these are less widespread than stem borer they have received less attention. They are less generally attracted to lights and moreover the use of DDT in nursery beds is very effective in some areas and consequently the forecasts of damage are less useful. DDT however is not useful in parts of Kyushu and Shikoku because of the general practice of seeding early to escape typhoon damage.

The rice leaf miner (Agromyza oryzella Matsumura), and rice leaf beetle (Lema oryzae Kuwayama) occur principally in Hokkaido and Honshu. Time of emergence and prevalence are determined by sweepings of a standard net at a specified time every two days during the period of emergence of the first generation and every five days thereafter. These are made at designated locations in each Prefecture, in nursery beds, and in randomly selected commercial fields. The

results are assembled and correlated with other data substantially as is done for rice leaf hoppers.

As to the rice skippers (Parnara guttata Bremer & Gray), a high positive correlation has been observed in Nagano Prefecture between mean minimum air temperatures for December and March on the one hand, and the number of larvae in the second generation and the number of adults occurring on flowers of red clover on the other hand. The possibility of applying these observations to other areas is being investigated. For this purpose a plot is seeded to red clover every year and the number of rice skippers on the flowers at approximately 10:00 a.m. each day is recorded throughout the period of emergence. In a nearby field of rice grown for the purpose, the number of larvae, pupae, and cast-off skins is determined for a unit area (3 tsubo; i.e. about 11 square feet) in the center of the field. Results are correlated with the air temperature and other meteorological data during the winter months.

Disease Forecasts

Rice Blast (Piricularia oryzae Br. et. Cav.): -- Studies relating to forecasting rice blast have been conducted since 1927. These include (1) overwintering of the fungus, (2) conidia production, (3) time of appearance and prevalence of conidia in fields, and (4) appropriate records of meteorological conditions and development of the rice plants.

Overwintering is determined by taking samples of rice straw from the inside and outside of straw stacks which are then cleaned and sterilized on the outside with a solution of mercuric chloride and exposed in a moist room at a temperature (25° to 28° C.) suitable for development of the fungus. Growth of hyphae and production of spores are recorded. Viablity of the spores is determined by a germination or dye test. The latter consists of treating the spores with equal amounts of 20 percent solutions of neutral red and methyl blue. Dead spores are dyed blue and living spores red. Samples are taken on the first and 15th of each month from March to June. Since overwintering has been established in the warmer Prefectures this study is limited to Honshu and Hokkaido.

In addition, samples of straw from an infected field are brought indoors in the fall and exposed to natural conditions at 10-day intervals from April 1 to June 30; beginning however in March in the warmer regions. The appearance of conidia is recorded and correlated later with temperature, moisture and other meteorological conditions.

The first appearance and prevalence of conidia in the air is determined by collecting spores at an elevation of 3 feet in paddy fields and at a lesser elevation in nursery beds and determining the number by examination under a microscope. Collections are made in a "prediction field" and in other fields throughout each Prefecture throughout Japan every day or every other day from the period of nursery seeding until ripening.

Permanent "prediction fields" are established in each district in which rice blast is likely to occur. Each field includes a variety that is highly resistant to blast, another of medium resistance and a third that is very susceptible. Infected straw is scattered in the field and half of each variety is fertilized with nitrogen at the normal rate and half at 1.5 times the normal rate. The varieties are the same year after year but not necessarily the same in all Prefectures.

The prevalence of blast is determined by examining 25 hills in each plot within 15 feet of the center and is expressed as a percentage of the number of stems and necks examined. The number of disease spots per leaf may also be recorded. Results are correlated with conidia counts and with meteorological conditions and stage of development of the rice plant. Prevalence in the "prediction field" is correlated with that in commercial fields in the same area. These studies relate mostly to neck blast but leaf blast is also considered.

Forecasts of neck blast are based largely on spore counts and weather, especially temperature and number of hours of sunshine. A rapid increase in spore count for a week or 10-day period ending 25 to 30 days before heading ordinarily means heavy infection and much damage whereas a light increase or no increase indicates little damage. The development of the rice plant is also important, since delayed growth increases the susceptibliity of the plants. It is therefore considered important to compare the development previous to heading with that of previous years. In the Tohoku region (northern Honshu) the time of appearance of the rice head also is important: A delay of more than 10 days as compared with the normal indicates heavy damage. Since the most effective treating period for neck blast extends from 10 days before to 10 days after heading there is ample time for making forecasts before treatment is necessary.

Use of an early Mongolian variety which is especially susceptible to blast offers some promise of improving the forecasts. Blast often causes heavy damage to this variety before it appears on others. All Prefectures from Hokkaido to Kyushu are being encouraged to include this variety in the studies in order to evaluate its usefulness.

Seedling Rot of Rice: -- Predictions of seed or seedling rot of rice are based on time of seeding as compared with the normal, and on meteorological conditions including especially air and water temperatures. Research includes determinations in a nursery plot seeded at the usual time and by usual methods of the germination, of infection, and of growth of the seedlings at five day intervals for 20 days after seeding. Seedling rot is thought to be especially likely to occur when the air temperature rises after a prolonged period of low temperatures. The danger is regarded as especially great if the water temperature falls to 13° C. for several days. Since damage may occur almost immediately, prompt action is necessary if severe losses are to be prevented.

Leaf, Stem, and Stripe Rust of Wheat and Barley: -- Research relating to forecasting epidemics of leaf, stem, and stripe rust of wheat and barley have been underway about ten years. Predictions are based on counts of spores collected in spore traps, on meteorological conditions and on plant development. Prediction fields similar to those for rice are established at key locations. In these fields susceptible varieties are seeded about ten days earlier than normal and 50 percent more than the normal amount of nitrogen is applied. The occurrence of rust in the fall, winter, and spring, and degree of infestation is recorded by reference to standard charts prepared by the United States Department of Agriculture. Studies are underway to determine whether infection occurs from overwintering spores or from those blown in from other areas.

Supplementary studies include records of infection on wild grasses along the roadside and in waste areas that are attacked earlier than are wheat and barley. The value of these records is yet to be established. Fall infection is thought to be especially important in relation to leaf rust since leaf rust spores are known to live over winter in Japan, under the snow in northern Japan.

Late Blight of Potatoes: -- Considerable attention is being given to late blight of potatoes. This disease makes its appearance in Kagoshima in southern Japan in April, western and central Honshu (Chugoku and Kanto areas) in late May or June and in Hokkaido in July. An appearance of the disease in southern Japan serves as a warning of possible damage to the north. Generally however the correlation is not sufficiently good to serve as a basis for prediction. However, an appearance of blight in Shizuoka Prefecture is a reasonably reliable index of its occurrence some three weeks later in the more northerly and generally higher Prefecture of Nagano.

NATURAL RESOURCES SECTION, GENERAL HEADQUARTERS SUPREME COMMANDER FOR THE ALLIED POWERS, JAPAN

THE EFFECTS OF SOME STONE-FRUIT VIRUSES ON CUCUMBER [1]

R. S. Willison

During 1950, a number of stone-fruit viruses were successfully transmitted to the cucumber varieties Windermoor Wonder, Chicago Pickling, and National Pickling, by rubbing the cotyledons with aqueous suspensions of macerated immature leaves from peach trees infected with known viruses or virus strains. Best results were obtained when the cucumbers were at the stage when the first true leaf was expanding. Transfers could be made from peach to cucumber throughout the summer as long as the axial growing points of the trees remained active. Attempts to transmit the diseases from immature leaves of sour cherry, sweet cherry, and plums have so far failed. The transfer of viruses from cucumber back to peach or cherry has not yet been tried. Some of the viruses have been serially transmitted from cucumber to cucumber from twelve to eighteen times. In most instances, the pickling varieties were somewhat more susceptible than Windermoor Wonder, but results were not always consistent in this respect. The viruses used in these experiments included one strain each of the viruses of sour cherry yellows and of tatter leaf of sweet cherry; seven strains of the necrotic ring spot virus, one of which was originally obtained from Lombard plum; and four strains of the prune dwarf virus, two originally from Italian prune and two from sweet cherry. Efforts to transmit the virus of X-disease to cucumber have not been successful.

Cherry yellows: -- In its effect on cucumber, the cherry yellows strain used was considerably more virulent than any of the others, except one strain of necrotic ring spot.

[1] Contribution No. 1104 from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

Primary symptoms on rubbed cotyledons appeared in two to four days, sometimes as pale green to chlorotic spots or rings with diffuse margins. Occasionally, when diluted sap was used, the primary spots persisted, at first more chlorotic and later greener than the surrounding tissue. More frequently the spotting was transitory, soon merging into vein-banding and general chlorosis. In such cases, the rubbed cotyledons often died in 7 to 10 days.

Systemic symptoms usually followed in six or seven days. The lamina of the true leaf expanding at the time of inoculation turned down, more or less at right angles to the petiole. Sometimes chlorotic rings or spots then appeared, but more commonly vein-banding, which rapidly diffused out into the interveinal tissues causing them to become chlorotic, then yellow and finally almost white, if the plants survived. The smaller unfolding leaves and axial growing points were usually killed in a week or ten days. In many of the series, the majority of infected plants collapsed at the top and died during the second week, though a few might survive for three or four weeks without further development.

In general, transfers from cucumber to cucumber, except when diluted inoculum was used, were more drastic in their effects and more quickly lethal than transfers direct from peach to cucumber.

Tatter leaf: -- The tatter leaf virus was the least virulent of those transmitted to cucumber. Primary symptoms were usually chlorotic rings, merging in six or eight days into vein-banding and chlorotic areas. The rubbed cotyledons usually persisted for several weeks.

Systemic symptoms were generally slow in appearing, consisting of vein-banding and small, chlorotic spots and rings, rugosity without severe leaf distortion, shortened internodes, and slow growth. Leaves on affected plants were frequently darker than normal. Leaves and growing points rarely died during the first three weeks.

Percentages of transmission from peach to cucumber were relatively low -- 30 to 40 percent. With successive transfers from cucumber to cucumber, however, the transmission rate rose to 70 percent or better, without appreciable increase in virulence.

Prune dwarf: -- Primary symptoms commonly resembled those of tatter leaf. However, cotyledons sometimes persisted, sometimes died. When persistent, they became abnormally large and very dark green, where not chlorotic.

Systemic symptoms developed sooner than those of tatter leaf, but the markings were of much the same type. Affected leaves, however, were more often twisted, blistered, and distorted. Green portions of leaves usually became very dark. Death of young leaves and growing points might or might not occur, but internodes were very short if the growing points survived. Early collapse and death of the tops of plants were much less frequent than with the cherry yellows virus. There were some differences in virulence between the several prune dwarf strains.

Necrotic ring spot: -- With the exception of one strain which behaved much like cherry yellows, symptoms induced by the necrotic ring spot strains tend to resemble those of prune dwarf. Differences between necrotic ring spot strains, between prune dwarf strains, and between the two viruses were mainly differences in degree, and not always consistent. Being intangible, they were of little diagnostic value.

One of the prune dwarf strains induced symptoms on Hubbard squash, and two of the necrotic ring spot strains have been transmitted to vegetable marrow and pumpkin. The possibility of using these plants as differential hosts is being explored.

In one experiment under artificial light and with controlled temperature and humidity, lengthening "the day" tended to hasten the appearance of primary symptoms and to delay systemic ones. With shorter periods of illumination, the systemic symptoms tended to be more severe. However, under greenhouse conditions during winter months, with short days and low light intensity, it was not possible to maintain the viruses on cucumber.

DOMINION LABORATORY OF PLANT PATHOLOGY, ST. CATHARINES, ONATRIO, CANADA

SURVEY FOR X-DISEASE ON PEACH AND CHERRY IN NEW YORK, INCLUDING THE FIRST REPORT ON SWEET CHERRY

K. G. Parker and D. H. Palmiter

Several reports on occurrence of X-disease on peach have been made in the Plant Disease Reporter, and its appearance on sour cherry has been described. The present paper gives the results of an orchard survey for incidence of the disease on cherry and peach. X-disease is reported on sweet cherry for the first time.

Summary of X-disease Discovery and Spread in the Hudson River Valley

In 1938, X-diseased chokecherries (Prunus virginiana) and peach trees were discovered, in Columbia, Dutchess, and Green Counties. The advanced stage of infection in some orchards indicated that the disease had been present for three or four years previous to its recognition. By 1939 the disease had spread westward across New York State along U. S. Highway 20 into western New York. New peach orchards were found infected in the three Counties listed above, and one peach orchard in Ulster County was found which showed symptoms. By 1940 the disease on chokecherries had spread south on the east side of the Hudson River in Putnam and Westchester Counties. On the west side of the Hudson, the disease moved slowly south in Ulster County, but no diseased peaches were found south of Ulster Park.

In 1943, two Columbia County cherry growers complained of English Morello trees that bloomed late and failed to set fruit. The following year the delayed bloom was observed and trees were marked for further study. In the same year, X-disease was seen on chokecherry at Slate Hill, in western Orange County for the first time. By 1945 diseased peach trees were found in Ulster County as far south as Highland and New Paltz, and diseased chokecherries were evident south into the eastern part of Orange County as an extension of the Ulster County occurrence.

In 1946, some of the cherries with delayed bloom and poor set of fruit were suspected of carrying X-disease because of their association with diseased chokecherries. The next season this was confirmed by transmission with buds placed on peach and cherry trees. Certain sweet cherry trees with small immature fruit on certain branches were also suspected of carrying the virus in 1947 but this was not confirmed by transmission trials until 1949.

By 1950 X-disease had spread south to the New Jersey border and infected orchards had been found in all the Hudson Valley fruit counties except Rockland.

In Table 1 are given the results of a survey made during 1949 and 1950 for X-disease in Hudson River Valley orchards.

Table 1. X-disease survey in Hudson Valley Counties during 1949 and 1950.

County	Number * Orchards	Peach X-disease			Number Orchards	Sour Cherry X-disease			Number Orchards	Sweet Cherry X-disease		
		Severe	Light	Total		Severe	Light	Total		Severe	Light	Total
Columbia	14	7	3	10	22	10	7	17	13	4	2	6
Ulster	27	17	7	24	8	5	0	5	12	4	1	5
Orange	15	3	2	5	5	0	0	0	4	0	1	1
Rockland	5	0	0	0	0	0	0	0	0	0	0	0
Dutchess	7	4	2	6	1	0	1	1	0	0	0	0

*Small blocks of trees of the same species owned by the same person are considered as one orchard unless they were separated by more than a mile, in which case they are considered two different farms even though owned by one person.

Occurrence in Western New York

In western New York, following the spread of X-disease across the State, it has occurred in all peach growing areas where chokecherry is common. In a band of varying width along Lake Ontario, chokecherry is rare and the disease has not been found there in peach, cherry, or on the occasional chokecherries occurring there.

X-disease was first observed on sour cherry in 1946, but evidence based on condition of the trees and statements of the growers indicates its presence on this species several years before. Symptoms on sour cherry already have been described (1).

In 1949, the disease was observed on sweet cherry for the first time in western New York, in Ontario County. Again, condition of the affected trees indicated the disease had been present for several years. The following year it was found on this species in Monroe and Chautauqua Counties. On trees on the mazzard rootstock the symptoms are chiefly a failure of the fruit to mature. Affected fruit is lighter-colored than normal, insipid, and somewhat pointed in shape. Affected fruit on light-colored varieties, such as Napoleon, is almost white and that on dark-colored varieties, such as Windsor, is light red to pink. Growth is reduced, and sometimes late in the season a discoloration is observed along the midrib of the leaves such as was described for the buckskin disease (2). Diseased trees on the mahaleb rootstock wilt, or decline, and die. Many roots are dead before there is evidence of disease above ground except for wilted or curled leaves.

It is of interest to note that along the shore of Lake Erie chokecherry is abundant and X-disease is as abundant there as in other parts of western New York, where chokecherry is correspondingly abundant. This is in sharp contrast to the conditions along the shore of Lake Ontario, where chokecherry is rare and X-disease is not known. Many orchards in the latter area have been examined with no X-disease found in a single one.

The results of the survey in western New York Counties during 1949 and 1950 are given in Table 2.

Table 2. X-disease survey in western New York Counties during 1949 and 1950.

County	Peach				Sour Cherry				Sweet Cherry			
	Number * Orchards	X-disease			Number Orchards	X-disease			Number Orchards	X-disease		
		Severe	Light	Total		Severe	Light	Total		Severe	Light	Total
Ontario	3	0	2	2	7	1	3	4	1	1	0	1
Wayne *	2	1	0	1	18	4	10	14	2	0	0	0
Monroe *	1	0	1	1	10	1	3	4	2	0	1	1
Orleans *	3	2	1	3	1	0	1	1	0	0	0	0
Niagara *	8	0	6	6	10	0	3	3	3	0	0	0
Chautauqua	2	1	0	1	6	2	0	2	1	1	0	1

*The data given are for the parts of these Counties south of the Lake zone, where Prunus virginiana is abundant. Where X-disease was present in the orchards, diseased chokecherries were observed or known to be present in the immediate vicinity. However, where X-disease was not found in the orchards, no chokecherries were observed in the immediate vicinity.

In general, even within the areas where chokecherry is common, if the immediate vicinity of orchards has been kept free of this wild species no diseased trees can be found in the orchards. Growers who keep their farms free of wild hedgerows and do not have areas of uncultivated land have no problem with this disease.

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DEPARTMENT OF PLANT PATHOLOGY, CORNELL UNIVERSITY, ITHACA, NEW YORK, AND DIVISION OF PLANT PATHOLOGY, NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, NEW YORK

SENSITIVITY OF SOME SPECIES OF FRAGARIA TO STRAWBERRY YELLOWS AND CRINKLE VIRUS DISEASES[1]

P. W. Miller

For some time it has been known that the species of Fragaria differ greatly in their sensitiveness to the various virus diseases of strawberry. Some species are very sensitive while others are highly resistant. Thus, Harris and King (2) have shown that the wild woodland strawberry of England (Fragaria vesca L.) and certain strains of F. virginiana Duchesne are very sensitive to both yellows and crinkle. In the United States, Demaree (1) has also found F. vesca, received from Harris, very sensitive to some strawberry virus diseases in eastern United States. Thomas (4) has shown that a form of F. vesca from California called var. californica is quite sensitive to yellows. Miller (3) has recently reported that a variant of F. vesca collected from near Seneca, Oregon, is also very sensitive to yellows. Harris and King (2) have reported that F. chiloensis (L.) Duchesne is a symptomless carrier, showing no visible symptoms of yellow-edge and crinkle virus diseases.

In a search for a wild strawberry species that would differentiate strawberry yellows from crinkle, the writer tested the Fragaria species and variants listed in Table 1. All inoculations were made with viruliferous aphids, and the same diseased plants, infected with severe yellows and crinkle respectively, were used as sources of inoculum. Three plants of each species were inoculated and all reacted similarly.

Table 1. Sensitivity of some species of Fragaria to yellows and crinkle of strawberry incubated at 70° to 80° F., Corvallis, Oregon, 1951.

Species[a]	Source	Sensitivity to crinkle: Days after inoculation: First symptoms noted	Sensitivity to crinkle: Days after inoculation: Plant dead	Sensitivity to crinkle: Order of sensitivity[b]	Sensitivity to yellows: Days after inoculation: First symptoms noted	Sensitivity to yellows: Days after inoculation: Plant dead	Sensitivity to yellows: Order of sensitivity[b]
F. vesca	Dee, Oregon	5-10	36-45	1	18	c	5
F. vesca	East Malling, England	14	c	2	11	c	2
F. vesca	Seneca, Oregon	15	c	3	14	31	1
F. vesca var. alpina	Horticultural variety Baron von Solenmaker (from seed)	15	c	4	21	c	3
F. vesca	California	20	c	5	39	c	4
F. vesca	Blachy, Oregon	21	c	6	20	c	6
F. sp.[d]	India	e	c	7	e	c	7
F. ovalis	Corvallis, Oregon	e	c	7	e	c	7
F. chiloensis	Seaside, Oregon	e	c	7	e	c	7

[a] F. vesca is used in the broad sense and includes several American forms considered species by some authorities.

[b] 1 indicates most sensitive. All numbered 7 were similar in rating.

[c] Still living after 90 days.

[d] Vesca-like plant (P. I. 166069).

[e] No visible symptoms of disease after 90 days.

[1] Cooperative project between the Division of Fruit and Vegetable Crops and Diseases, U. S. Department of Agriculture and the Oregon Agricultural Experiment Station; published with the approval of the Director of the Oregon Agricultural Experiment Station as Technical Paper No. 682. Contribution of the Department of Botany and Plant Pathology.

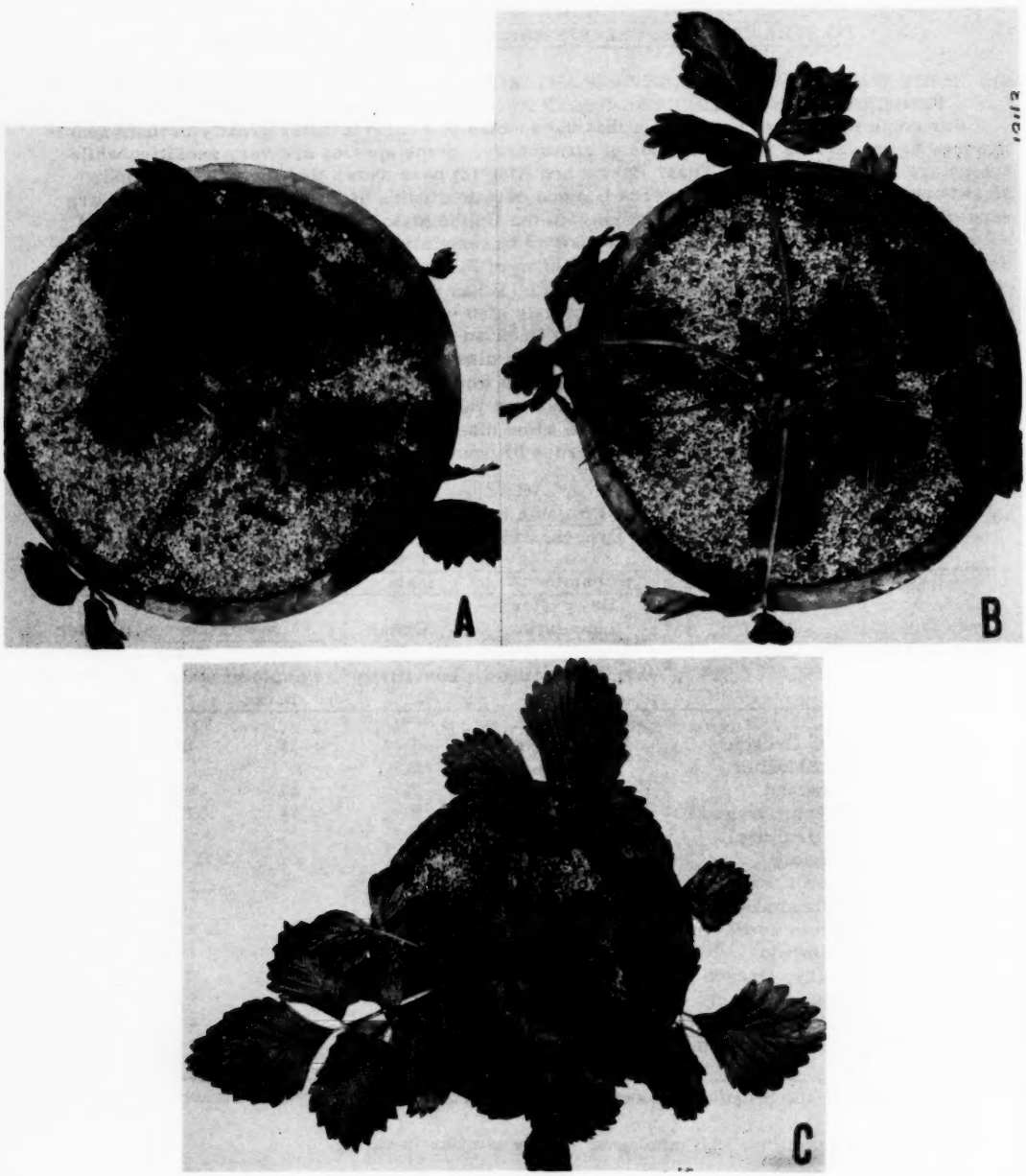

FIGURE 1. A. F. vesca from Seneca, Oregon, infected with strawberry yellows; photographed 53 days after inoculation with viruliferous aphids. B. F. vesca from Dee, Oregon, infected with crinkle; photographed 39 days after inoculation with viruliferous aphids. C. F. vesca from Dee, Oregon, infected with yellows; photographed 39 days after inoculation by viruliferous aphids. (Photographs by H. H. Millsap).

Table 1 shows specifically that different species of Fragaria vary greatly in sensitivity to the same strains of yellows and crinkle. F. vesca[2] from Seneca, Oregon was the most sensitive to yellows (Fig. 1, A) and that from Dee, Oregon the most sensitive to crinkle (Fig. 1, B). Fragaria species (P. O. 166069, a vesca type from India), F. chiloensis and F. ovalis (Lehm.) Rydb. were all highly tolerant to both diseases.

Perhaps the most important practical contribution resulting from this investigation is the discovery of F. vesca from Dee, Oregon, that will differentiate crinkle from yellows. On this host, the first symptoms of crinkle are visible 5 to 10 days after inoculation; at that time the edges of the youngest leaf begin to curl downward. Soon thereafter, the older leaves begin to wilt and gradually die. The new leaves formed are curled up and greatly dwarfed (Fig. 1, B). In 36 to 45 days after inoculation the plant is dead. By contrast, yellows causes only a general yellowing and slight dwarfing of the foliage on this host. The leaves do not curl up and die. (Fig. 1, C).

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[2]This clone was found to be triploid by Dr. H. Dermen. A note on it will appear in the near future.

NUMBER OF APHIDS AND TIME REQUIRED FOR THE TRANSMISSION OF STRAWBERRY YELLOWS[1]

P. W. Miller

The investigations of Massee (1, 2), Vaughan (5), Zeller and Vaughan (6), and others have shown beyond doubt that the strawberry aphid, Capitophorus fragariae Theob. (now called C. fragaefolii (Ckll.)), is a vector of both strawberry yellows and crinkle. However, the minimum number of wingless (apterous) and winged (alate) viruliferous aphids per plant required for the transmission of both yellows and crinkle and the minimum infection feeding period have not been definitely established. Prentice and Harris (3) obtained transmission of the mild crinkle virus by using only two viruliferous aphids per plant. In a later paper, Prentice (4) reported that he had obtained transmission of the mild yellow-edge virus (virus 2) on Fragaria vesca with one viruliferous aphid after a two-day infection feeding period. However, with the variety Royal Sovereign, he failed to obtain transmission of the same virus with only one viruliferous aphid even after an infection feed period of three days. Massee (1, 2), Vaughan (5), and Zeller and Vaughan (6) all used five or more viruliferous aphids per plant in their transmission studies, and these readily transmitted both yellows and crinkle. For satisfactory control, it is essential to know the minimum number of aphids per plant required for transmission and the minimum feeding period on infected plants for them to infect healthy plants. Experiments designed to determine these two points in relation to strawberry yellows were carried on during 1950. There follows a discussion of the methods used in these studies and the results obtained.

Minimum Number of Aphids Required to Transmit Strawberry Yellows

One, two, three, and five wingless aphids, respectively, from a colony of viruliferous aphids maintained on a yellows-infected Fragaria vesca plant were transferred by a moistened camel's-hair brush to each of a number of healthy F. vesca plants kept in cages for a week, after which the aphids were all killed. The results of these inoculations are given in Table 1.

Table 1. Number of viruliferous aphids per plant required for transmission of strawberry yellows to Fragaria vesca, Corvallis, Oregon, 1950.

Number of viruliferous aphids per plant	Plants	
	Inoculated	Infected
	Number	Percent
1	34	41
2	18	72
3	30	73
5	37	89

As shown by the data given in Table 1, one viruliferous wingless aphid transmitted strawberry yellows to a relatively high percentage of F. vesca plants. However, the percentage of positive transmissions increased with the number of viruliferous aphids on the plant. It is believed that in at least some instances where a single aphid apparently failed to transmit the virus, the insect was injured during transfer to the indicator plant and died before it could feed thereon. Young aphids are particularly subject to fatal injury, unless extreme care is exercised.

Minimum Aphid Feeding Period Required for Infection

Prentice and Harris (3) reported that both mild and severe yellows are occasionally transmitted after feeding periods of one hour but that the proportion of infections increases with increasing infection feeding time.

[1]Cooperative project between the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture and the Oregon Agricultural Experiment Station; published with the approval of the Director of the Oregon Agricultural Experiment Station as Technical Paper No. 670. Contribution of the Department of Botany and Plant Pathology.

In the writer's experiments on the relation of feeding period to infection, healthy wingless aphids from a stock colony maintained on a healthy F. vesca plant were transferred to a plant severely infected with yellows and allowed to feed for 1/2 up to 3 hours, after which three aphids were transferred to each of a number of healthy F. vesca plants (from an East Malling clone), where they were allowed to feed for 5 to 8 days. The results of these experiments are given in Table 2.

Table 2. Relation of duration of feeding period of wingless aphids on a yellows-infected plant to transmission of yellows to Fragaria vesca, Corvallis, Oregon, 1950.

Feeding period on infected plant	Plants	
	Inoculated	Infected
Hours	Number	Percent
1/2	13	0
1	19	26
2	14	50
3	16	93

It would appear from the results given in Table 2 that a wingless aphid may become viruliferous after feeding for only one hour on an infected plant. However, as might be expected, the longer the feeding period the greater the likelihood of aphids becoming viruliferous.

Discussion

From the foregoing it is evident that a single wingless viruliferous aphid may, under greenhouse caged conditions, transmit strawberry yellows to F. vesca after relatively short feeding periods (1 to 3 hours). Whether winged forms are as efficient in the transmission of strawberry yellows remains to be determined. The discovery that a single wingless aphid may transmit strawberry yellows after relatively short feeding periods calls for a reexamination of control programs. It appears essential to control the insect vector absolutely in areas where certified plants are propagated and isolation is not complete if the spread of yellows is to be prevented. This calls for detailed information on the life history of the strawberry aphid and a possible re-orientation of the control program to periods of multiplication and spread of the insect. In addition to the development of satisfactory insecticidal dust and spray control programs, the possibility of absolute control by the use of non-phytocidal systemic organic insecticides should be given attention.

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A METHOD FOR INOCULATING VARIETAL TEST NURSERIES WITH THE WHEAT STREAK-MOSAIC VIRUS[1]

H. H. McKinney and H. Fellows

Wheat mosaics have occurred sporadically in the hard winter wheat region since the late twenties, and with the alarming outbreak of streak-mosaic in Kansas in 1949 (1), it became evident that methods should be devised whereby wheats can be tested on a large scale for their reactions to the disease in the field.

Streak-mosaic virus does not overseason in the soil, therefore wheats cannot be tested against the virus by the simple methods used in areas where the rosette-mosaic and kindred mosaics occur. Furthermore, we have no means of using a vector for inoculating large nurseries. Under these circumstances, efforts have been directed towards the perfection of methods whereby virus could be produced in quantity, and inoculation accomplished by manual and mechanical means. The streak-mosaic virus transmits rather easily by means of the carborundum-wiping method described earlier (3). However, the method is too slow and laborious for large populations. Streak-mosaic virus spreads from diseased to healthy plants when there is an intermingling of the leaves in locations where there is much leaf movement, but spread by this method has been very slight. Infection can be induced to a limited degree by whipping the leaves of healthy plants with mosaic plants. This method has been more effective than alternately drawing diseased and healthy leaves between the thumb and index finger, but neither of these methods is suitable for rapid, large-scale inoculations. A successful spraying method for inoculating beans growing in test plats, with mosaic virus, was reported by Richards and Munger (4). The present studies were concentrated on the development of a similar method for inoculating wheat with the streak-mosaic virus.

PRODUCTION OF THE VIRUS FOR THE INOCULUM

All virus used in these studies was derived from the original collection of the yellow streak-mosaic virus collected near Salina, Kansas in 1932 (2). This collection is as virulent as any that has been collected since 1932. The virus was increased in the Michigan Amber and Westar varieties of winter wheat cultured in 6-inch clay pots. At Beltsville, good results were obtained when the mosaic plants were cultured in a greenhouse in which the temperatures ranged from 50° to 65° F. at night and on over-cast days, during the fall, winter, and spring. Good results were obtained during the summer of 1950 in a shaded greenhouse and also with plants grown out of doors. At Manhattan, good results were obtained with potted plants grown out of doors with shade during the summer of 1950. Several crops of mosaic leaves may be harvested from winter wheat plants cultured under such conditions. Plants grown in the cool greenhouse yielded about 1 gram of fresh turgid leaves each, whereas those grown out of doors yielded about 3.5 grams each, at a single harvest.

PREPARATION OF THE INOCULUM

Eighty grams of fresh turgid mosaic wheat leaves and 1440 cc. of water constitute a suitable sample when a blendor of the Waring type is used. The tissue is first clipped with shears, and then put through a hand type food chopper with the fine cutting plate. The juice and all of the chopped tissue, including that remaining in the chopper, are added to 720 cc. of water. The suspension is then poured into a piece of fine mesh surgical gauze doubled, and the tissue is squeezed thoroughly with the hands. This residue is put in the blendor with the remaining 720 cc. of water. The blendor is operated for two minutes with the lid pressed tightly in place. The contents of the blendor are then poured on the double gauze, the tissue squeezed thoroughly by hand, and the residue discarded. The two batches of liquor are combined. Foaming in the blendor is greatly reduced when the original juice is removed in the first extraction. The 80 grams of leaves yield from 72 to 77 grams of juice and fine solids carried in the 1440 cc. of water.

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[1]Cooperative investigations between the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Kansas Agricultural Experiment Station. Contribution No. 516, serial No. 413, Department of Botany and Plant Pathology, Kansas Agricultural Experiment Station.

Thus, the juice, virus, and other fine solids, are diluted little over 20 times.

When a blendor is not available, the juice is squeezed from the chopped tissue in the gauze, by hand; the tissue is then thoroughly rinsed in water, removed and squeezed in the gauze. The total amount of water used equals 19 times the weight of the fresh leaves. The resulting dilution of the juice and fine solids approximates that obtained by the blendor method.

INOCULATION

An abrasive was added to the inoculum at the rate of 2 grams per 100 cc. Celite (Johns-Manville, analytical filter grade), and carborundum (silicon carbide, 600 grain, and coarse grade FFRA), have been used successfully. All variety nursery inoculations have done with celite. When small populations of plants were inoculated, excellent infection occurred when the seedlings were sprayed with the inoculum and abrasive in a DeVilbiss No. 15 nasal type atomizer, followed quickly by drawing the leaves between the thumb and index finger.

With large nurseries, the inoculum was applied to the plants by means of the DeVilbiss, type AG spray gun, designed for art and decorative work. The No. 290 air cap, and the "F" fluid tip were found to conserve both air and inoculum. The gun was removed from its glass reservoir, and a rubber tube of suitable length was attached to the liquid intake tube of the gun. The other end of this tube was attached to a metal tube leading through the cover of a two-quart Mason jar. The air hose was attached to the aspirator lead of the gun and to the air compressor.

Two operators are required, one to attend the compressor, and hold the jar of inoculum, and the other to do the inoculating. The inoculum must be agitated to keep the abrasive in suspension. This is done by the operator holding the jar above the level of the spray gun, and shaking it gently. The second operator works in a kneeling position, which allows the inoculum to flow to the gun. The air in the jar is replaced through a hole in the top or around a loose-fitting top. The air pressure is maintained between 25 and 30 pounds per square inch at the compressor.

With the left hand supporting the plants, the spray nozzle is held 1 to 1 1/2 inches from the plants, and the leaves are sprayed thoroughly, as the operator moves along the row in a crouched position or on his knees. Plants have not been rinsed with water after inoculation in the field tests. The amount of inoculum required has ranged from 5 to 11 cc. per foot of row, depending on the size of the plants. This delivery rate is obtained when the air and the liquid valves are opened just wide enough to give a continuous spray. When the liquid valve becomes clogged, the obstruction usually can be freed by opening the valve slightly, and adjusting back to the working position. Care must be exercised to prevent small bits of tissue getting into the inoculum while it is being prepared.

RESULTS

In pilot tests with Michigan Amber winter wheat grown in greenhouses at Beltsville, Maryland, the spray-gun method, with celite in the inoculum described, as well as in inoculum that was one-half the described virus concentration, has rarely failed to infect 100 percent of the plants that have reached the first- to the third-tiller stages of development. From 68 to 100 percent of the plants became infected when no abrasive was used. Younger plants in the pre-tiller stage have given lower percentages of infection, probably because of the relatively small leaf surface available for inoculation.

The coarse carborundum (FFRA) has been more effective than the fine grade (600 grain), or the celite, but the celite has been favored in this work because of the relative ease with which it can be kept in suspension, and because it does not seem to cut the nozzle parts excessively as does carborundum. Furthermore, inoculum containing a mild abrasive or possibly no abrasive, should offer better opportunities for the detection of resistant wheats, than inoculum containing a more effective abrasive.

At Manhattan, Kansas, a fall-sown wheat nursery, which was kindly provided by E. D. Hansing, was inoculated on April 26, 1950. The plants were 6 to 8 inches tall, measured to the tips of the longest leaves, and in active growth. All of the 35 varieties developed mosaic, in from 80 to 95 percent of the plants. Another fall-sown variety nursery was inoculated on October 10, 1950, 5 weeks after seeding. Fall observations indicated infection in all of the plants examined. However, an epidemic of leaf rust prevented an accurate evaluation of the mosaic throughout the nursery.

Observations made April 30, 1951, indicated the presence of mosaic in each of the 81 varieties of wheat in the nursery. Within the varieties, from 95 to 100 percent of the plants had mosaic.

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DIVISION OF CEREAL CROPS AND DISEASES, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, DEPARTMENT OF AGRICULTURE, AND DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, KANSAS AGRICULTURAL EXPERIMENT STATION, MANHATTAN

"ISHUKU-BYO" (DWARF) OF SWEETPOTATO IN THE RYUKYU ISLANDS

Eaton M. Summers [1]

An apparently new, undescribed, virus disease of sweetpotatoes has appeared in the Ryukyu Islands since the close of the war. It is so destructive that sweetpotato culture has been discontinued in large areas. Present indications are that vast additional acreage will suffer the same fate. There is no virus disease known anywhere else in the world that is such a serious threat to sweetpotato production. Virus diseases known in the Ryukyus previous to the war were very mild, and Ryukyuan scientific workers are of the opinion that "ishuku-byo" was introduced by natives repatriated from the Trust Territory, probably Saipan or Tinian, [2] who brought diseased sweetpotatoes back to the Islands.

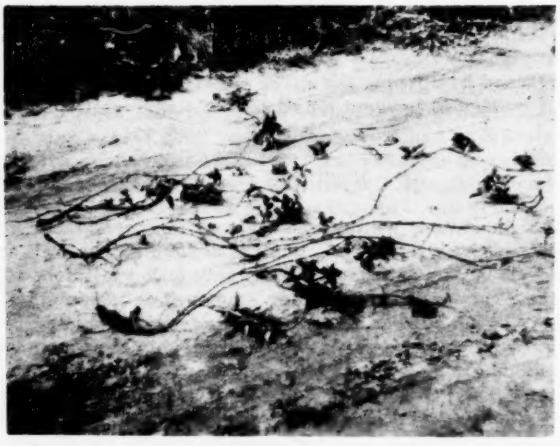

FIGURE 1. Effect of "ishuku-byo" virus disease on sweetpotato vines.

Figures 1 and 2 show the effect of the disease on the growth of the plants. No edible sweetpotatoes are produced on diseased vines. It is said that the incubation period is 70 to 120 days, so that many plants are affected without symptoms being apparent. Entire fields, even very

[1] Agriculturist, United States Civil Administration of the Ryukyu Islands.

[2] In a discussion, with Dr. Harold T. Cook, who served on Tinian in 1945 as an Agricultural Officer in the Navy, he stated that he had not observed this disease on either Tinian or Saipan although sweetpotatoes were an important crop and were grown extensively. From this it would appear that either the sweetpotatoes on Tinian and Saipan were resistant or the disease was not present on those islands at that time. P.R.M.

FIGURE 2. Left, early infection with "ishuku-byo". Right, infection late in season.

large areas, have been observed in this condition. Visible symptoms consist of excess proliferation of young shoots from leaf axils and dwarfing of subsequent growth. Little or no latex is present in diseased plants or roots.

Attempts to control the disease by roguing have proven only partially successful and cannot be expected to provide any permanent benefit. Maintenance of a source of certified virus-free vines for planting purposes may be a palliative measure but will probably be very difficult if not impossible of realization. Some differences in degree of susceptibility of different varieties of sweetpotatoes are evident, but no real resistance to this virus disease has been found in any variety now growing in the Ryukyus.

"Ishuku-byo" apparently occurs throughout the Islands and, as indicated, seems to threaten the very existence of sweetpotato culture there. It is a definite threat to sweetpotato growing in other parts of the world, particularly Japan because of its close proximity to the Ryukyus and the constant movement of people to and fro between the two places. The introduction of such a destructive disease into Japan, which will surely happen unless utmost caution is exercised, could readily prove to be a major disaster because the sweetpotato is an important crop there, furnishing 13 percent of the indigenous food production.

A constant vigil should be maintained and preventive measures planned. The reaction to "ishuku-byo" of all Japanese sweetpotato varieties should be ascertained by sending them to the Ryukyus for testing. This knowledge will be invaluable should the disease be introduced into Japan. Resistant varieties, if there be any, should be used in future breeding programs to provide a practical control, even though the disease should never be introduced. This is the very best type of insurance for a continuing successful agricultural production program. Recommendations have been made for detailing Japanese scientists to survey the sweetpotato situation in the Ryukyu Islands so that a future course of action may be determined, particularly from the standpoint of the threat of this disease to sweetpotato growing in Japan.

UNITED STATES CIVIL ADMINISTRATION OF THE RYUKYU ISLANDS

POTATO WART IN AMERICA [1]

R. E. Hartman

From the time that potato wart (Synchytrium endobioticum (Schilb.) Perc.)) was first found in the United States (September 1918) it has been considered a menace to potato production in this country. For many years prior to that time it was prevalent in the principal potato-growing countries of Europe and the British Isles. Severe losses occurred in many potato fields of Europe, and the disease was considered one of the most serious by English authorities. In 1909 this disease was reported from Newfoundland, and soon thereafter State and Federal authorities in the United States took precautionary measures to exclude it from this country. In 1912 the Federal Horticultural Board established a quarantine on importation of potatoes from Europe and other areas where this disease was prevalent, but the disease evidently had arrived the preceding year when several million bushels of potatoes had been imported from Europe.

Potato wart is still confined to the very small area from which it was first reported due to the strict regulations that have been applied to the importation of foreign potatoes, as well as those governing the growing of potatoes in the infected areas. The early finding of immunity in some well-known varieties and now in many of the newly developed seedlings has also helped very much in the control of this disease. In addition, its establishment is controlled by mean soil temperature and to some extent moisture relationships. There are, however, large areas in the United States with a climate similar to that of the districts of Pennsylvania, Maryland, and West Virginia in which wart has already been found, and unless precautions are continued and wart eradicated from infected areas it could be spread to other sections.

POTATO WART IN PENNSYLVANIA

The potato wart problem in Pennsylvania, from the discovery of the disease in 1918, has received continuous experimental study in addition to maintaining a strict quarantine in all known infected areas. The quarantine regulations governing the growing of potatoes, inspection of crops grown, and regulation of the movement of root crops from infected areas, have been an effort to prevent the spread of the disease to other areas and by prohibiting the planting of non-immune potatoes in infected gardens to hasten its elimination by starvation. Experimental studies of the wart organism, environmental factors, wart resistance or immunity, and soil sterilization have been a very desirable and essential part of the wart program in Pennsylvania.

A summary of wart investigations up to 1950 establishes the following conclusions:

(1) Soil temperatures are a limiting factor in the development of the disease i.e., wart will not establish itself in areas with mean soil temperatures of 70° F. or higher, and such mean temperatures are found in areas with a growing season of 140 days or longer.

(2) Resting spores of the disease are capable of remaining alive in the soil for a long period, 20 to 25 years, in heavy sods, meadows, and abandoned weed patches. However, the organism, in the absence of susceptible host plants, disappears rather rapidly in sandy soils or if fallow or semifallow culture is practiced, possibly within ten years.

(3) Wart spreads very slowly i.e., transportation of infected host tissue, soils, etc.).

(4) Unless wart is entirely eradicated it will quickly re-establish itself under garden culture if susceptible potatoes are planted.

(5) Immune potato varieties (in the sense that they do not propagate the disease) now under certification include: Spaulding Rose, Cobbler, Green Mountain, Katahdin, Mesaba, Mohawk, Sequoia, Warba, Ontario, Pawnee, Kennebec, Chisago, Calrose, and Red Warba.

(6) Soil sterilization or wart eradication: (a) Ammonia sulfo-cyanate applied at the rate of 2,500 pounds per acre to old infections eradicates the disease provided the organic content of the soils is low or diminished by cropping, and (b) finely pulverized copper sulfate applied at the rate of 2,500 pounds per acre and/or 5% solution of 40% formaldehyde applied at the rate of 20 gallons per square foot have been found to be the most practical and effective wart eradicants and are now used exclusively in Pennsylvania.

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[1] Presented before Eastern and National Plant Boards, New York City, September 26, 1950.

WART ERADICATION

Wart eradication from 1932 to 1946 inclusive, was a slow, hand operation. Gardens were spaded, cultivated, and then wart-eradicated by the application of copper sulfate at the rate of 2,500 pounds per acre. The chemical and sawdust mixture was thoroughly worked into the soil by garden cultivators.

It was apparent for a long time that this slow method of treatment would delay final eradication of wart infected areas for many years. To overcome this handicap, and increase the rate of eradication, this project in 1947 was supplied with mechanical equipment. This equipment included cletrac tractors, garden tractors, plows, discs, large utility trucks and specially equipped 600-gallon power tanks and chemical (lime) spreaders.

A review of our eradication efforts at the close of the 1950 season showed that the disease had been eradicated completely from 440 infected gardens, 333 were treated and undergoing check planting, and the balance of 340 infected gardens in 11 remaining infected villages to be eradicated during the 1951 to 1957 period. Table 1 summarizes eradication already accomplished and anticipated future results. Wart eradication has now a definite pattern or method and final elimination of all presently known infections should be completed by 1957 under one of the following methods:

Table 1. Progress of potato wart eradication in Pennsylvania, 1932 to 1957.

Total Number	Year			
	1932	1942	1947	1950
Infected gardens	937	1,073	1,111	1,113
Infected towns and villages	100	108	108	108
Infected counties	12	15	15	15
Infected gardens eradicated	0	229	375	440
Infected gardens under eradication	0	42	49	333
Infected towns and villages eradicated	0	21	25	34
Infected towns and villages under eradication	0	5	10	63
Remaining infected gardens	937	804	736	340
Remaining infected villages	100	82	73	11

Wart eradication summary 1932 to 1958	
Total number of gardens	1,113
Mine Operations	180
Total Destruction	181
Standard Eradication	372
Spot treatment	380
TOTAL	1,113

Wart eradicants 1932 to 1950	
Ammonium Thio-Cyanate ...	50,000 Lbs.
Copper Sulfate	475,000 Lbs.
40% Formaldehyde	10 Bbls.
1951-1957 (Estimate)	
Copper sulfate	150,000 Lbs.
40% Formaldehyde	10 Bbls.

(1) Destroyed -- A total of 180 gardens were destroyed by mine operations; i. e., strippings, cave-ins, etc. This number may be increased by continuing mine operations.

(2) Total Destruction -- Many infected gardens were abandoned as a result of mine operations or evacuated due to depletion of coal deposits; such areas are totally destroyed by excessive applications of copper sulfate. These abandoned gardens in most cases have been unused for years and are found to be overgrown with brush and weeds, and covered with accumulated rubbage. These areas are carefully cleared of all brush, weeds, etc., then plowed and disced to facilitate thorough applications of copper sulfate.

The cultivated portions of abandoned gardens are treated with pulverized copper sulfate by mechanical spreaders at the rate of 10,000 pounds per acre and the berms and abandoned foundations are treated with copper sulfate solution by 600-gallon power tanks at the rate of 8,000 pounds per acre.

(3) Standard Eradication -- This method of eradication is applied to infected gardens which are used by owners or tenants as vegetable patches.

This method has three phases: (a) The cultivated portion of the garden is plowed and disced and copper sulfate applied at the rate of 2,500 pounds per acre by mechanical spreaders.

(b) the berms are cleared of brush, weeds, rubbish, then subsoiled, etc., and totally destroyed by copper sulfate solution applied at the rate of 8,000 pounds per acre. (c) Lawns, flower beds, shrubs, and trees, are treated with a 5% solution of 40% formaldehyde applied at the rate of 20 gallons per 100 square feet. After eradication, the cultivated portion of the garden is check-planted with susceptible Russet Rural potatoes for a period of four successive years.

(4) Spot Treatment Eradication -- This eradication method is used in gardens known to have been infected, but in which non-immune potatoes have been cultivated for at least 20 years. This eradication method is accomplished in three phases (a) The berms are cleared of brush, weeds, rubbage, then subsoiled, etc., and totally destroyed with copper sulfate solution applied at the rate of 8,000 pounds per acre. (b) Lawns, flower beds, shrubs, and trees are treated with a 5% solution of 40% formaldehyde, applied at the rate of 20 gallons per 100 square feet. (c) The cultivated portion of the garden is plowed, disced, and planted to susceptible Russet Rural potatoes. In the fall these plantings are carefully harvested to determine the presence or absence of potato wart infection. This check planting is continued for four years. If no infection is found during this period of check planting the garden is considered free of potato wart. If a few individual hills are found infected, the area around each infection (20 square feet) is sterilized by application of 10% formaldehyde solution applied at the rate of 2 gallons per square foot. The garden is then continued under check planting. However, if wart is found in 5 percent of the plantings this method is discontinued and the garden is treated by standard eradication methods.

(5) Lawn, Shrub, and Berm Treatment -- In a limited number of infected areas the cultivated garden has been discontinued and the entire area landscaped; i.e., sod, flower beds, shrubs, etc. These infections are totally eradicated by the application of a 10% solution of 40% formaldehyde applied at the rate of 20 gallons per 100 square feet.

Experience has indicated that all berms and lawns should be treated after frost in the fall. The destructive effect of treatment on landscaped areas, if made in spring or summer, causes a great degree of civic resistance due to temporary leaf and grass destruction; however, the effects of fall treatment are scarcely noticeable and will have measurably disappeared by spring, with no permanent injury to lawns, shrubs, etc.

(6) Check Planting -- Under standard and spot treatment eradication, all treated gardens are check-planted with susceptible Russet Rural potatoes for a period of at least four years under the following rotation: the first year the whole cultivated garden is planted; the second and third year alternate halves of the garden, and the fourth and final year the entire cultivated garden is again check-planted.

These check plantings are kept in a good state of cultivation, and sprayed throughout the growing season. After the crop is mature it is harvested and each hill and tuber is minutely inspected for the presence of potato wart.

In all eradication work the necessity for keeping all equipment and personal attire sterile must receive constant vigil, to prevent spreading the disease within the infected area or to non-infected areas.

This is accomplished by sterilizing all equipment, boots, and oilskin coveralls with a 10 percent solution of 40% formaldehyde, using high pressure spray tanks equipped with extension hose and special spray nozzles.

This sterilization is maintained from the start of eradication, through planting, cultivating, spraying, and harvest operations. Each individual garden is considered a separate unit and all equipment and raiment is sterilized before and after each operation.

WART IMMUNITY

The first experimental work with potato wart was a check of all common potato variety groups for wart susceptibility. Results were very encouraging as it was found that Green Mountain, Cobbler, Spaulding Rose, and McCormick groups were immune.

The 1948 National Breeding Program Bulletin (19th Annual Report) by Dr. F. J. Stevenson lists 31 new varieties under certification in the United States as a result of breeding programs or somatic mutation developments. All these new varieties have been checked for wart immunity with the following results.

Wart Susceptible		Wart Immune
1 Chippewa	12 Marygold	1 Katahdin
2 Sebago	13 Pontiac	2 Sequoia
3 Houma	14 Satapa	3 Warba
4 Kosota	15 Russet Sebago	4 Calrose
5 Menominee	16 Canus	5 Mohawk
6 Teton	17 Potomac	6 Ontario
7 LaSalle	18 Progress	7 Pawnee
8 Empire	19 Waseca	8 Kennebec
9 Chenango	20 White Pontiac	9 Chisago
10 Essex	21 Dakota Chief	10 Red Warba
11 Erie		

PENNSYLVANIA STATE DEPARTMENT OF AGRICULTURE

THE CONTROL OF PECAN SCAB BY FUNGICIDES[1]

R. J. Higdon

The Schley variety of pecan, widely planted in the commercial nut orchards of South Carolina, is one of the more susceptible varieties to pecan scab (Cladosporium effusum). The results of an experiment in which several fungicides were evaluated for scab control are given in this paper.

Methods and Materials

Plots that consisted of four trees each and replicated four times were set up in an orchard of the Schley variety near Batesburg, South Carolina. This orchard had not produced a crop of pecans in several seasons because of infection by the pecan scab fungus. The sprays were applied with a power sprayer.

The plots were treated as follows: (1) Check (no spray treatment); (2) Bordeaux Mixture applied as 4-1-100 formulation for the first application (pre-pollination) and as a 6-2-100 formulation for the later applications; (3) Bordeaux Mixture as in (2) for the first two applications, followed by four later applications of ziram (zinc dimethyl dithiocarbamate) 2-100; (4) ziram, 2-100 for all applications; and (5) Orthocide 406 (N-trichloromethylthic tetrahydrophthalimide) 4-100 for all applications. Orthocide 406 was not applied at pre-pollination. The fungicides were applied six times (except Orthocide 406 which was applied five times) during the season. The first spray was made April 17 before pollination occurred; while the remaining applications were made at approximately 30-day intervals, with the last application on September 12. DDT was added to the fungicides at the recommended times to control the pecan case bearer and the pecan weevil.

Experimental Results

The green shucks of pecans on the trees were examined for scab infection during the third week in September. The results of this examination are presented in Table 1. Shucks of pecans observed on unsprayed trees were 93% severely scabbed (Table 1). None of the sprayed trees produced more than 40% severely scabbed nuts. The Bordeaux Mixture-Ziram combination and Orthocide 406 (Orthocide 406 without a pre-pollination spray) produced more nuts in Class 1 and 2 than any other fungucide treatment used.

Table 1. Effect of fungicides on incidence of scab. [a]

Treatment	Number of trees sprayed	Number of shucks examined	Percent infection per class [b]				
			1	2	3	4	5
None	16	164	0.00	0.00	0.60	6.00	93.30
Zerlate	16	1531	0.75	0.95	27.95	30.75	39.60
Bordeaux-Zerlate	16	1642	0.12	2.18	41.10	38.60	18.00
Bordeaux Mixture	16	1777	0.23	1.20	39.30	24.67	34.60
Orthocide 406	16	1686	0.35	6.50	41.95	30.30	20.90

[a] Scab data are based on shucks of pecans which could be readily observed from base of tree.

[b] Percentage shucks infected as based on the empirical classification suggested by Dr. J. R. Cole, Pecan Station, Albany, Georgia:

CLASS
1 -- no infection on shuck
2 -- 1-3 initial infections on shuck
3 -- 4 or more initial infections on shuck
4 -- few secondary infections on shuck
5 -- numerous secondary infections on shuck

[1] Acknowledgment is made to E. I. du Pont de Nemours and Company, Inc., and to California Spray-Chemical Corporation for furnishing certain spray materials used in this experiment.

The effect of each fungicide treatment on the number of nuts per pound was determined from random samples collected from representative trees at harvest time. The differences in unit weight (number per pound) of nuts obtained from the Bordeaux Mixture, Bordeaux Mixture-Ziram, and the Orthocide 406 sprayed trees were not significant (Table 2). The nuts from the Ziram sprayed trees and the unsprayed trees were significantly less in weight than the nuts from the trees sprayed with Bordeaux Mixture, Bordeaux Mixture-Ziram combination, and Orthocide 406.

Table 2. Number of pecans per pound as affected by treatments.

Fungicide Treatment	Number of trees sampled	Number of pecans weighed	Average number of pecans per pound
None	11	1125	112.50
Zerlate	9	1266	105.50
Bordeaux-Zerlate	8	1698	87.25
Bordeaux Mixture	8	1053	87.75
Orthocide 406	10	1053	87.75

These data indicate that the Bordeaux Mixture-Ziram combination schedule is superior to Ziram for the control of pecan scab. However, Bordeaux Mixture alone gave sufficient scab control to permit production of good quality pecans as indicated by the number of nuts per pound, see Table 2. Under the conditions of this experiment, Orthocide 406 appeared very promising as it was applied only five times in comparison to six spray applications for the other fungicides.

Summary

Bordeaux Mixture, Orthocide 406, and Bordeaux Mixture-Ziram controlled the pecan scab fungus to the extent that good quality nuts were produced. Ziram alone was not a satisfactory fungicide, due possibly to its poorer sticking qualities.

DEPARTMENT OF HORTICULTURE, EXPERIMENT STATION, CLEMSON COLLEGE, CLEMSON, SOUTH CAROLINA

TREATMENT OF SHORTLEAF PINE AND LOBLOLLY PINE SEED WITH FUNGICIDAL DUSTS

J. R. Hamilton and L. W. R. Jackson

One of the vital problems confronting foresters in the management of forest nurseries is securing an effective treatment for the control of damping-off diseases. Since the early part of this century, the Pathologists have prescribed a variety of chemical treatments which have shown varying degrees of effectiveness. The most extensively used treatments have been aqueous solutions of formaldehyde, sulphuric acid and aluminum sulfate which are applied to the surface of the prepared beds at the time of sowing. During the past two decades, a variety of fungicidal dusts have been widely used for the control of diseases of field crops. Thus far, very few reports have been made on the use of chemical seed protectants for the control of tree seedling diseases. The chief purpose of the study reported in this paper was to determine the effect of various levels of dosage of fungicidal dusts on the germination and emergence of unstratified and stratified seed of shortleaf pine and loblolly pine.

HISTORICAL REVIEW

There are only a few reports in the literature on the treatment of tree seed with chemical protectants. In 1921, Hartley (3) reported that he could see no advantage in seed treatment except in the prevention of seed decay before the start of germination.

In one of the earliest reports, Metcalf (6) treated redwood seed with Semesan, Bayer dust and mercuric chloride. In 1929, Baldwin (1) treated white pine seed with Uspulun and Dip-dust. Uspulun caused chemical injury while Dip-dust increased germination by 10 percent. In 1934, Horsfall (5) et al. stated that red copper oxide treatment injured Scotch pine seed and increased the germination of mugho pine seed. In 1938, Davis et al. (2) stated that preliminary tests on the treatment of conifer seeds with fungicidal dusts and dips had been inconclusive. Nevertheless, they thought that further trials were needed, especially where the treatment of the seed bed is not practical and where the losses are due to pre-emergence damping-off.

In 1939, Horsfall et al. (4) reported that the treatment of pine seed with red copper oxide and zinc oxide proved effective. They recommended that one-half teaspoon of the fungicide be applied per pound of seed and then rotated in a drum with baffles for 30 to 40 revolutions.

METHODS

The fungicides tested in the experiment were as follows; Arasan, 50 percent active material, Barbak C., New improved Ceresan (5 percent active material), Fermate (20 percent active material), Phygon (80 percent active material), Puratized 641, New Improved Semesan Jr. (1 percent active material), Yellow Cuprocide (100 percent active material), and a 1:1000 aqueous solution of mercuric chloride. The dosage levels of the dusts used were 1.0, 0.25 and 0.0625 percent of the seed weight. Glass vials of the treated seed were rotated in a small drum with baffles until the seeds were thoroughly coated, which required approximately 460 revolutions. Seed was soaked in the mercuric chloride solution for one minute.

The seed was stratified in a mixture of peat moss and sand for 30 days at 10° C.

The seed were germinated in flats of untreated Norfolk coarse sand. The daily air temperature during the germination period ranged from a minimum of 65° F. at night to a maximum of 80° F. during the day.

A planting of 2 rows of 25 seeds was made of each treatment. Daily counts were made of the emerged seedlings. All of the germination tests were run for a period of 50 days from planting. The tests were run in a split-plot design. Each treatment was replicated 3 times. The least significant differences between treatment means and dosage level means were determined by analysis of variance.

EXPERIMENTAL RESULTS

Treatment of Unstratified Seed

Loblolly pine seed: -- The average germination of the control was 30.6 percent. The germination in the treated series ranged from a minimum of 16.6 percent for Puratized 641 to a maximum of 38.6 percent for 0.25 percent Phygon.

The following treatments increased the percentage of germination; 0.25 percent Fermate,

and 0.06 percent Semesan Jr. The other dosage levels of the fungicides tested did not increase the germination percentage. All of the dosage levels of Yellow Cuprocide, Barbak C., Ceresan and Puratized 641 decreased germination. Mercuric chloride also decreased germination.

There was not a sufficient amount of damping-off in this series of treatments to determine the relative efficacy of the various fungicides.

Shortleaf pine seed: -- In this series of treatments, the average germination of the control was 57.6 percent. In the treated series, the germination ranged from a minimum of 40 percent for 1 percent Puratized 641 to a maximum of 70 percent for 0.06 percent Fermate. The following treatments increased the percentage of germination: 1 percent Yellow Cuprocide; 0.25 and 0.06 percent Arasan, Barbak C, Fermate, Phygon, Puratized 641, and Yellow Cuprocide; 0.06 percent Ceresan; 0.25 percent Semesan Jr. All the other dosage levels of the fungicides, including mercuric chloride, decreased the percentage of germination.

The percentage of damping-off was reduced by the following treatments: 1 percent Barbak C, Ceresan, Phygon, Yellow Cuprocide; and 0.06 percent Semesan Jr. Mercuric chloride also reduced damping-off.

Treatment of Stratified Seed

Loblolly pine seed: -- Germination of the control was 55.2 percent. The germination of the treated series ranged from a minimum of 48.8 percent for 1 percent Semesan, Jr. to a maximum of 71.4 percent for 0.25 percent Phygon. The percentage of germination was increased by the following treatments: all the treatments at the 1 percent level, except Ceresan and Semesan Jr.; all the treatments except Ceresan at the 0.25 percent level; and all the treatments except Yellow Cuprocide at the 0.06 level.

There was not sufficient damping-off in this series to indicate the relative efficacy of the various fungicides.

Shortleaf pine seed: -- The average germination of the control was 53.2 percent. Germination of the treated series ranged from a minimum of 36.0 percent for Puratized 641 to a maximum of 68.6 percent for 0.06 percent Puratized 641.

The following treatments increased the percentage of germination: 1 percent Fermate, Semesan Jr., and Yellow Cuprocide; 0.25 percent Ceresan, Yellow Cuprocide, Fermate, and Semesan Jr.; and 0.06 percent Arasan, Barbak C, Ceresan, Fermate, Phygon, Puratized 641 and Yellow Cuprocide.

The percentage of damping-off was reduced by the following treatments; 1 percent Fermate, Phygon; all the treatments except Barbak C at the 0.25 percent level; 0.06 percent Arasan, Barbak C, Puratized 641, and Yellow Cuprocide.

SUMMARY

A study was made of the effect of 3 dosage levels of each of 8 fungicidal dusts on the germination of stratified and unstratified shortleaf pine and loblolly pine seed.

According to the results of this experiment, the 0.25 and 0.06 percent dosages of the various fungicides resulted in a larger number of emergence increase percentages than did the 1 percent dosages.

In the unstratified seed series, including both species, the number of treatments that resulted in increased emergence were as follows: 4 of 16 for 1 percent dosage, 8 of 16 for the 0.25 percent dosage, and 7 of 16 for the 0.06 percent dosage.

In the stratified seed series, including both species, the number of treatments that resulted in increased emergence were as follows: 9 of 16 for 1 percent dosage, 11 of 16 for 0.25 percent dosage, and 14 of 16 for the 0.06 percent dosage.

For all treatments, including both species, the number of treatments that increased emergence were as follows: 13 of 32 for 1 percent dosage, 19 of 32 for the 0.25 percent dosage, and 24 of 32 for the 0.06 percent dosage.

According to the results of this study, the fungicidal dusts at particularly the 0.25 and 0.06 percent dosages, can be used for the treatment of unstratified and stratified seed.

There was not sufficient damping-off in the treatment series to yield an evaluation of the relative efficacy of the fungicidal dusts.

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GEORGIA AGRICULTURAL EXPERIMENT STATION AND UNIVERSITY OF GEORGIA, ATHENS

NEW OR UNUSUAL RECORDS OF PLANT DISEASE OCCURRENCE

ANTHRACNOSE ON MICHIGAN PEACHES

By M. A. Smith

On August 30, 1950, anthracnose was found in a commercial shipment of Halehaven peaches from St. Joseph, Michigan.

The causal fungus was readily isolated in pure culture, and its pathogenicity to peaches and apples was proved by inoculations. The organism is pink, the color being that of the mycelium itself. After ten days' growth on potato-dextrose agar perithecia had begun to form and mature asci and ascospores were observed after 30 days' growth at a temperature of 77° F.

Conidia averaged 5.7 x 18.4 microns; asci averaged 10.2 x 57.0 microns; and ascospores averaged 6.3 x 17.3 microns.

Many workers have reported the production of the perfect stage by gray or gray-green strains of Glomerella cingulata. This appears to be the first recorded instance of the production of the perfect stage by a pink strain of the fungus and, insofar as can be determined, this is the first report of the occurrence of anthracnose on Michigan peaches.

DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES, CHICAGO, ILLINOIS

THE OCCURRENCE OF TOBACCO ANTHRACNOSE IN NORTH CAROLINA

By C. J. Nusbaum

Tobacco anthracnose (Colletotrichum sp.) has been observed in plant beds in five counties in North Carolina. Specimens showing heavily sporulating lesions on the leaves were brought into the laboratory from a plant bed in Columbus County April 4. A few days later additional specimens were received from Craven and Carteret Counties. In mid-April, the disease was found in Johnson and Edgecombe Counties. Disease development at the Columbus County site was restricted to a small spot in one bed. In Craven County the disease appeared in small areas scattered over one bed site and reduced the stand of plants. In other locations the disease was scattered and of little consequence.

Isolations were made and inoculation of tobacco plants in the greenhouse, using spores from pure cultures, produced symptoms similar to those observed in the original material. Although it seems likely that anthracnose has occurred previously in North Carolina, no published reports of its occurrence in this State have been found.

PLANT PATHOLOGY LABORATORIES, NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA

NEW RECORDS OF CONIOTHYRIUM HELLEBORI IN THE UNITED STATES

By Donald P. Limber

Coniothyrium hellebori Cke. and Mass., the cause of black leafspot of Helleborus niger L., is reported to be the most destructive disease of this ornamental plant in England (1) and Holland (2). As shown in Weiss' Check List Revision (3) this disease has been reported from Maryland, New York, and Oregon. California, New Jersey, and Ohio should now be added to the list of States in which the disease has been found. The collections on which this statement is based are listed here.

Coniothyrium hellebori Cke. & Mass. on Helleborus niger L., collected at Kuiah, California, April 24, 1933, by W. H. Wheeler and C. E. Cooley (Seattle No. 264).

Coniothyrium hellebori Cke. & Mass. on Helleborus niger L., collected at East Rutherford, New Jersey, November 17, 1950, by L. M. Fenner, R. A. Fox, and D. P. Limber (Hoboken No. 16648).

Coniothyrium hellebori Cke. & Mass. on Helleborus niger L., collected at Mentor, Ohio, in January 1951, by Philip M. Kohankie (Hoboken No. PE-101), and at Chesterland, Ohio, in January 1951, by P. M. Kohankie (Hoboken No. PE-102).

The California collection was determined by N. Rex Hunt. The infected plants had been imported not long before the specimens were collected, and it is possible that the disease did not become permanently established.

In Ohio and New Jersey the disease occurred on Helleborus plantings which had been grown there for several years. The stock of the Mentor lot was procured in Virginia.

The collections reported here represent a doubling of the known distribution of C. hellebori in the United States. It is very probable that the published distribution records of many other diseases of the less important ornamental plants are quite as incomplete. Such information is essential to proper application of plant quarantine regulation of imported plants. To facilitate appropriate quarantine action on such imports, we request that plant pathologists report all diseases of the minor ornamental plants which may come to their attention.

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U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH ADMINISTRATION, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, HOBOKEN, NEW JERSEY

FIRST OBSERVATIONS IN 1951 OF SPOT ANTHRACNOSE ON FLOWERING DOGWOOD IN MARYLAND

By R. A. Jehle and Anna E. Jenkins

The disease was observed on bracts of wild white flowering dogwood on April 30. It was general and severe on many trees examined in several different localities: El Dorado, Dorchester County; Girdletree, Pocomoke, Snow Hill, and Stockton, Worcester County. At Pocomoke the anthracnose was unusually destructive, many bracts being distorted and stunted as well as abundantly dotted with the small brown spots. A few lesions already were detectable on the young, expanding leaves. At Snow Hill mild spotting was observed on bracts of the same pink flowering dogwood tree on which the disease was discovered on leaves last season (June 14) (cf. Jehle and Jenkins Plant Dis Reptr. 34: 225-226. (1950). Slight infection also was present on bracts of pink dogwood on still another residential property at Snow Hill and on one at Stockton. This appears to be the first record of the disease on bracts of pink dogwood. Farther north in the State, that is, in the vicinity of Rockville, Montgomery County, bract infection on white flowering dogwood, observed last year on May 12, was again present this season (May 6). Specimens of the disease from Maryland were exhibited over television (WMAL) on May 15, by W. H. Youngman.

DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF MARYLAND AND DIVISION OF MYCOLOGY AND DISEASE SURVEY, BUREAU OF PLANT INDUSTRY, SOILS AND AGRICULTURAL ENGINEERING

PAPERS PRESENTED AT THE MEMPHIS SYMPOSIUM ON THE TEACHING OF PLANT PATHOLOGY

The papers given at the symposiums of the Pittsburgh and New York Meetings of the American Phytopathological Society in 1948 and 1949 were published in the April and September 1950 numbers of the Reporter.

A third symposium on this topic was held at the Memphis Meeting of the Society in December 1950. The special committee responsible for this program consisted of G. C. Kent, chairman, and J. G. Leach, Thomas Sproston, M. F. Kernkamp, G. F. Weber and L. D. Leach. Five of the six papers presented on this program follow. -- P.R.M.

BASIC PRINCIPLES IN THE SCIENCE OF PLANT PATHOLOGY WHICH SHOULD BE STRESSED IN THE BEGINNING COURSE

W. B. Allington

INTRODUCTION

Students in the beginning course in plant pathology naturally fall into two groups: (1) those who will take no more courses in plant pathology and (2) those who will continue their study of the subject in future courses. The latter group will receive a repetition of much which was taught in the beginning course with additional examples and a further refinement of the broad principles given earlier.

A beginning course therefore, in order to adequately accommodate these students, can really accomplish only two general purposes: (1) to impart a knowledge of the basic principles with well chosen examples, stressing that they are only examples, and (2) to enable the student to read understandingly and to know how to find the information.

The methods and techniques of teaching, naturally are extremely variable and this is all for the good of a science. The principles which are taught, however, should be quite constant in any particular branch of science at a given time. Many plant pathologists at the present time are of the opinion that there is not enough standardization in regard to the basic principles taught our beginning students. The reasons for this belief stem partly from difficulties experienced by students who change institutions midway in their training period. Sometimes great difficulty is experienced in evaluating credits and in choosing courses which are suitable under the circumstances.

BASIC PRINCIPLES

I have chosen to discuss briefly eight principles which I think should be stressed in the beginning course in Plant Pathology. I am not suggesting in any manner the method to be used in teaching and therefore no significance is attached to the order in which I discuss these principles.

1. The nature of the etiological agents: -- Logical thinking cannot proceed without a clear concept in regard to the entities with which we are dealing. We cannot take for granted that the beginning student realizes the paramount importance of bacteria, fungi, and viruses as the incitants of a diseased condition. Some of the students may already have a background which will furnish them this acquaintance but others may not, depending of course upon the formal prerequisites for the course. It is a foregone conclusion that at least one course in botany will precede the course under discussion. In that course, usually the study of the microorganisms is not emphasized greatly but more thought is given to the higher plants.

2. History of plant pathology: -- A brief treatment of the history of the science is necessary in order to orient the student and to establish for him a reasonable perspective. Without this, his sense of judgment in regard to the importance of various phases of plant pathology, or indeed plant pathology itself, may be unsound. Regardless of his future activities he must judge developments in the field as they arise.

3. Physiology of host and parasite: -- The beginning student must realize that the host and the parasite each has a distinct physiology. This fundamental fact must be fully realized before one is ready for the more complicated concepts of host-parasite relations. I think that this is one of the most vital principles which must not be overlooked.

4. Host-parasite relations: -- Host-parasite relations constitute, perhaps, the nucleus of the science. It perhaps constitutes the most lucid part of the course for the student. The

production of disease symptoms should be well outlined, calling particular attention to the incubation period.

5. Epidemiology: -- The underlying causes behind the occurrence of epidemics should be clearly outlined. This perhaps involves a good account of the nature of epidemics, both natural and artificial, and an evaluation of such factors as overwintering and dissemination.

6. Relation of environment to plant disease: -- Since the factor of environment is almost inseparable from any discussion of plant disease, this phase of plant pathology can hardly be overstressed. The point should be made that environment is often the limiting factor in disease development and may act on either the host or parasite or the combination of the two in its influence.

7. Principles of control of plant diseases: -- The broad principles of disease control may be classed as follows:

(1) Eradication
(2) Exclusion
(3) Protection
(4) Host resistance

In addition to a discussion, with working examples, of these principles perhaps one should point out the weaknesses of each and possible improvements.

8. Relation of plant pathology to other branches of science: -- We need to define the sphere of plant pathology more closely than we have and the best place to start getting that idea across, I think, would be in the beginning course. The trend has been for plant pathologists to spread out too far into other fields in order "to get the job done". Too often, the student is introduced to the subject with the idea that all a plant pathologist thinks about is to control plant disease. Granted, this may be the ultimate goal of his efforts, but first he is concerned with the more immediate task of unraveling some of the hidden mysteries of the host and parasite relationship.

PLANT PATHOLOGY DEPARTMENT, UNIVERSITY OF NEBRASKA, LINCOLN

OBJECTIVES AS RELATED TO PRESENTATION METHODS IN TEACHING GENERAL PLANT PATHOLOGY

C. C. Allison

Before considering presentation methods, it would be logical to consider some of the objectives of an introductory course in plant pathology. Obviously these objectives cannot be obtained in blocks of lessons, but should be developed throughout the course.

One of the primary objectives in teaching is to arouse the interest of the student in the subject matter and to maintain that interest throughout the course. This objective must always be closely correlated with presentation methods. Another objective is to see that the students obtain an appreciation of the specific importance of plant diseases in crop improvement, in the economy of agriculture, in livestock production, and of their general importance in human affairs. Presentation methods should allow the student to develop concepts through his own thinking. A concept of disease development, and the complexity and interrelation of the numerous factors which affect disease development, as well as the self-development of the principles of plant disease control are important objectives. In so far as possible, experience in research methods and disease control techniques could be considered definite objectives.

Factors besides the objectives which will affect the method of presentation used will include the tradition in the department or college, the background of the students in courses and experience, and the personality and ability of the instructor. Of these, tradition probably exerts too much influence in many departments, unless the instructor uses the best of previous experiences and methods in continually revising the general course.

The type of courses the student has had and the methods of teaching he has experienced in these background courses might well be considered in selecting presentation methods for each class. Certainly, if general botany with a physiological approach is a prerequisite, then the approach to plant pathology would be different than if little or no botany of any sort were required

Another important factor which will influence the method of presentation used is the personality and experience of the instructor. The best of the qualified instructors and the best presentation methods should be used since, for many students, this is the only direct contact with a course in plant pathology. Their evaluation of the science of plant pathology, to a great extent, depends upon their impressions from this course. If the course is too impractical, that may be their impression of the science; if it is limited entirely to practical applications, they feel that the science is merely a tool, when actually plant pathology has both applied and basic relationships to biological problems.

A discussion-laboratory method of presentation is preferred to the usual separation of the beginning course into lecture and laboratory periods. This preference is based on the opinion that concepts must be self-developed, and that such development is better encouraged when the student has before him materials from which the essential facts may be obtained. Mutual discussion aids him in evaluating his own opinions and those of others. The method is designed to discourage the telling of facts and the cookbook laboratory exercise passed on from one generation of students to another by way of notebooks.

There is nothing new about this method since it is probable that all instructors of plant pathology use it in some degree whether or not they recognize it. The extent to which this method is used, of course, must vary with the various factors discussed above. The idea is to aid the students to obtain information themselves from the materials before them, to reason clearly on the basis of the observations they have made, and to draw further inferences on the basis of these conclusions and additional observations. The facts are clarified by mutual discussion initiated by the students and by leading questions from the instructor during the class period.

In this method the students obtain sufficient information about the development of the disease and the causal agent to suggest the logical principles of control. They readily see the importance of a knowledge of suscepts, causal agent, and ecological and biological factors in determining control measures, and thus do not need to memorize specific control measures. This manner of teaching in which the student plays such a large part, should soon result in recognition of the fact that basic research by qualified plant pathologists is needed to avoid mistakes in crop improvement programs and disease control recommendations. As the course develops, the student begins to realize the broad scope of research and the need of cooperation of several qualified people in various scientific fields within agriculture. Charts to indicate the integration of crop improvement programs at several State experiment stations and regional laboratories are useful in this respect.

No specific examples will be given in this printed discussion since almost any disease could be used from which to develop certain principles by the discussion-laboratory method. Success with the method is dependent upon the student, the instructor, and the administration of the department. Each student must be supplied with specimens and tools, including good prepared slides in some instances. Kodachrome slides of symptoms, disease control practices, experimental field plot results, and stained cross sections are all valuable. Formal, front table displays alone are not nearly sufficient. The instructor must realize that the discussions are joint enterprises. If points to be emphasized are kept well in mind, skillful questioning should result in the students emphasizing these points themselves.

It is further felt that the discussion-laboratory method does more than allow a student to develop certain concepts regarding plant diseases and plant pathology. Practice in obtaining, utilizing and discussing facts certainly aids in the development of self-reliant, logical, and analytical approaches to any type of problem in whatever field the student may ultimately be employed.

BOTANY DEPARTMENT, OHIO STATE UNIVERSITY, COLUMBUS

TOPICS OR ITEMS TO BE INCLUDED IN A BASIC COURSE IN PLANT PATHOLOGY [1]

B. H. Davis

One of the many problems we face in teaching a basic course in plant pathology is the selection of topics or diseases for study. Certainly we do not lack for topics, but the more of them selected, the less time can be devoted to each. The question is which topics to select and how much time to spend on each. Four points may well be considered in relation to this question.

First, it would appear to be logical and an elementary assumption that the topics to be included should be based on our objectives.

One main objective certainly should be to provide the student with a fundamental knowledge of the subject, to teach him a terminology which will enable him to understand at least semi-technical papers and express himself accurately and clearly, and to supply a fund of generalizations and usable facts with which he can solve some of the problems he meets in the field.

Another objective should be to provide training in observing, in clear thinking, and in drawing inferences.

A further objective should be to acquaint the student with the role of plant pathology in agriculture, in other words, to see plant pathology as a whole in its relation to at least the other plant sciences.

And, of course, in teaching any subject, one hopes to further the student's general education and culture.

Second, it is assumed that the fundamental concepts and generalizations will be remembered, not the details. If we group, generalize, and correlate we are giving the student the greatest help. Of course, generalizations without facts are worthless and often dangerous. However, the student can get facts easier than he can arrive at generalizations. It is often said that this or that statement should not be made because there are exceptions. At the basic course level, exceptions are of little concern to me. There is plenty of time in advanced undergraduate and graduate courses to stress exceptions and to discourage the student's idea that he knows the subject after he has memorized points 1, 2, and 3. It should not be inferred from these remarks that there should be spoon feeding. The process of teaching should create interest and raise questions in the mind of the student and then guide his thinking until he has arrived at logical answers to his questions.

Third, it is assumed that the course is being taught for students of the plant sciences and not just for plant pathology and possibly some botany majors. Therefore I see no reason for discouraging students or limiting enrollment in order that more time may be spent with the majors. Certainly plant pathology and agriculture will be helped if the majors in soils, farm crops, agricultural economics, plant physiology, and horticulture who will become farmers, county agents, field men for commercial companies, or Ph. D.'s in their respective fields, have a basic knowledge of our science. If we teach from the standpoint of students in other fields, then we should help them integrate plant pathology with their own fields as well as with agriculture as a whole. This should not be left entirely for the course in horticulture. When disease is the main factor in production, it is to be stressed, but likewise let us be honest and point out just as readily when disease is relatively unimportant. Time spent in correlating our science with the other fields of agriculture may be more profitable than adding more facts about a given disease. A view of the forest as well as of the trees is important.

Fourth, we are all trying to teach efficiently and therefore must consider the amount learned in relation to the amount of time spent, that is, time spent by the student, not by the professor. "Amount learned" must include not just facts but also techniques, skills, and mental training. All of us have taken courses in which our time was not used to the best advantage. In such courses, little thought was given to how much benefit we could derive from the discussion or laboratory work on the topics selected, and little time was spent or effort expended to enable us to make good use of our time. The student certainly deserves the chance to learn and to learn the most for his efforts. What he does with his chance is up to him. What is efficient use of time for one student may not be for another. This is recognized, and we must establish a mean for the class. We face similar problems every day in determing the level of the discussion and the amount of repetition unless we teach by the individual conference method. I do not propose to answer the question of what is efficient use of the student's time.

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[1] Also paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University -- The State University of New Jersey, Department of Plant Pathology.

In this connection, however, we might well ask ourselves this question: Of what value is the particular topic, and what is to be gained by its study? Certainly, with the limited time available, the study of each topic must serve a very definite purpose and help us realize our objectives in teaching the course.

Not all of us will or should arrive at the same answer to the question of which topics to select and the amount of time to spend on each. Some of us have three-hour courses, others four. Some have mainly seniors, others have sophomores. We teach in different parts of the country with varied crop interests. The student's background of courses also must be considered.

Bearing these various points in mind, I have the following preference for topics in a basic course:

Topic 1 is an outline of our objectives, our methods of meeting these objectives, and the obligations of both the professor and the student. Certainly the student deserves this consideration.

Topic 2 is symptomatology. It is safe to say that the student on entering the course is thinking in terms of the cause of disease, with little regard to the suscept plant. A study of symptoms makes him think in terms of the responses of the diseased plant, their classification, their variation in relation to the organs, tissues, age, and variety of the suscept, and their role in diagnosis. The question of why symptoms are of value in diagnosis might well be asked. It is here that the student begins to realize that the physiological processes in diseased tissues are normal for that set of conditions.

Topic 3 may well be the study of some physiogenic disease or group of diseases. This should also serve the same purpose as the study of symptoms; namely, to get the student to think pathologically rather than etiologically about disease. In selecting topics, I have eliminated these in my basic course, but if time were available I should certainly elect to study them at this stage of the course.

Topic 4 is the presentation of a complete outline for the study of a disease. Many of us use the Cornell outline; some use other outlines. Regardless of the one used, it should be complete so that the student can organize and catalogue the information he may derive from the study of any disease. An outline aids not only the student but also the instructor. To me it serves as a reminder that by the end of the term we should arrive at generalizations about each item of the outline for the science as a whole.

Topic 5, which is closely correlated with topic 4, is the study of some one disease which illustrates all the phases of the outline. Brown rot of stone fruits, fire blight, late blight of potato and tomato, or some other disease can be used, depending on when or where the course is given. The particular disease does not matter, so long as we have a reasonable amount of information on each item of the outline, especially the life history. It is here that the student has to define and become familiar with the use of such terms as "life history", "life cycles", "primary cycles", "inoculation", "inoculation period". Practice in formulating definitions is usually much needed even at the junior and senior levels. It would appear that the most logical time to stress the meaning of terms and to practice defining is with the study of the first disease. Also here is a good place to consider pathogenicity if the disease selected is adaptable.

From this point on, we should study as many type diseases, as regards suscept response, cause, and control, as possible in order to broaden the student's viewpoint and to arrive at generalizations. In selecting topics and diseases, we must have a three-fold purpose; (1) to acquaint the student with the facts about each phase of that particular disease, (2) to give the student some idea of the entire group to which it belongs, and (3) to bring out generalizations on some one or two phases of plant pathology. We haven't time to emphasize every phase of every disease studied. We can emphasize two or three phases and generalize on these for the science as a whole. For example, the disease or diseases selected in the downy mildew group (late blight of potato, downy mildew of grape, blue mold of tobacco, or downy mildew of cucurbits) should acquaint the student with these diseases and the downy mildew group. Downy mildew diseases are also excellent ones to show how climatic or environmental factors influence the prevalence of disease and to bring out early history in the study of fungus pathogenes if late blight or downy mildew of grape is studied. In this way all phases of plant pathology can be emphasized one or more times during the study of the several diseases.

Grouping as to type may be as follows: downy mildews; fungus leaf spots; powdery mildews; rusts; smuts; fungus wilts and other diseases caused by soil-borne pathogenes; bacterial diseases (blights, leaf spots, soft rots, and wilts); virus diseases; and wood rots.

The number of types and the number of examples within each type may be varied according to time available. Likewise, the order should be varied according to locality, semester, and availability of fresh material. This is more important to me than the taxonomic position of the pathogene.

The reasons for the grouping and the phases to be emphasized are obvious for most of these. We have already mentioned the physiogenic diseases and a disease such as brown rot where emphasis may be placed on terminology, pathogenicity, and organizing factual material according to an outline. We have already mentioned the downy mildews and epiphytology.

The fungous leaf spots represent a rather distinct type of disease. Apple scab, cherry leaf spot, Septoria leaf spot of celery, black rot of apple, and the leaf spots caused by species of Cercospora and Phoma serve as examples. This type represents a great number of diseases, and at best only a few representatives can be studied. To be sure, they differ in many ways but they also have basic similarities, and the study of one helps materially in the study of all the others. Personally, I should like to study about six diseases; three of annuals or herbaceous perennials and three of woody plants, that is, one causing leaf spots, one causing leaf spots and stem cankers, and one causing leaf spots, stem cankers, and fruit and/or seed lesions. Unfortunately, time is too limited. We study apple scab and observe three or four other leaf spot diseases. Then in discussion we build up the life histories according to the crop, field culture, type of propagation, plant part affected, and marketable product. Control measures such as crop rotation, seed treatment, use of foliage protectants, and sanitation follow according to life history and culture. In this way I feel we are making the most of the time we have and are encouraging the student to think for himself. The final examination always involves questions on hypothetical leaf spot diseases for which the student is to give likely answers. I see little reason for considering those diseases caused by Ascomycetes and then some time later considering those caused by species of the fungi imperfecti.

Since the foliage protectants are used so extensively for the control of leaf spots, it would appear that their study should follow this type of disease. Certainly the leaf spots pave the way for the concept of protection.

A study of the powdery mildews brings in differences in disease relationships, and this is to be stressed. Obligate parasitism, specificity, and pathogenetic races need an introduction.

The study of the rusts calls for considerable time in that it is an excellent type for stressing hybridization and genetics of pathogenes, pathogenetic races, obligate parasitism, hypersensitivity, and problems involved in breeding for disease resistance.

The study of smuts should serve to broaden the student's knowledge of types of suscept response and life histories of pathogenes. This study serves also as an excellent background for seed treatments from the standpoint of killing pathogenes in and on the seed and for seed certification.

The study of bacterial diseases introduces a new type of pathogene and it becomes necessary to generalize regarding agents of inoculation, ingress, type of responses, history, and other phases. At this stage of the course I feel the students have sufficient background that completeness in the study of a disease can be sacrificed for more diseases. A more superficial study of a bacterial blight, a leaf spot, a soft rot, a bacterial wilt, and crown gall should acquaint the student with bacterial diseases.

The only point common to the topic designated as diseases caused by soil-borne pathogenes is that the causal agents can live for a number of years in the soil in the absence of the suscept. This is in contrast to refuse-borne pathogenes, which die after the suscept tissue disintegrates. Again I feel that complete studies can be sacrificed here. A few facts about damping-off, club root, potato scab, root knot are sufficient. More time is necessary with the fungus wilts, since we want to emphasize toxins and disease resistance of a different type. The study of soil-borne pathogenes establishes the need for seed protectants and crop potation. We cannot pass this group without considering the factors affecting the soil-borne organisms.

The study of virus diseases introduces a different etiological agent and necessarily calls for generalizing on the various phases. Personally, I have found that I can accomplish most by first showing kodachromes to aid in recognition of mosaics, yellows, ring spots, and other types, then by either giving limits or generalizing on thermal inactivation, longevity, agents of inoculation, movement in the suscept, specificity, over-wintering and control. To me this method seems preferable to the study of one or two diseases which may give a poor impression of viruses and virus diseases as a whole.

The wood rot diseases introduce a new group of pathogenes and type of life history. Enzyme production and the breakdown of woody tissues are the important phases.

Another topic to be considered is the term paper. The best way for the student to become acquainted with sources of plant pathological literature, to use plant pathological terms, to evaluate data, and to draw conclusions is to write a term paper on some one disease or topic. With increased enrollment I have shifted this to the advanced course. However, this topic belongs in the basic course.

The last topic is a summary of the course: topics studied; generalizations arrived at in connection with the headings of the outline, such as inoculation, ingress, infection, and types of control measures; and repetition of the objectives mentioned at the beginning of the semester.

There is one more point which should be emphasized in connection with some one disease. Most of us find the time too short to integrate the control measures for the disease we are studying with the whole disease control program for that crop. This should be done for some one crop -- potato or tomato is very satisfactory -- so that the student can see how a control program is built up and how the cultural practices, the various diseases, and the storage and marketing practices influence this program.

If these topics and types of diseases are studied, generalizations made, some few techniques explained or practiced, examples drawn from all types of crops, I believe the student will have an appreciation of plant pathology which will help him in any of the plant sciences. If he chooses to be one of the minority and continue his studies in plant pathology, we have plenty of time to teach him skills, techniques, and mycology and to make sure he has the ability and the interest to make a good pathologist.

RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

BLUEPRINT FOR AN IMPRACTICAL COURSE

Russell B. Stevens

In preparation for this discussion I first read over the individual papers from two previous symposia, one at Pittsburgh and one at New York. Needless to say the topics treated and the opinions expressed vary, but I think we find in the second paragraph of the very first paper by Dr. Kern a key to the whole effort. As he says, "In general the purpose of this conference is the interchange of experience among teachers of plant pathology."

The second paper, by Dr. McNew, is the kind which I should really like to give! If you remember, it was a discussion of a new approach to the elementary course, presumably in use at Iowa State, stressing the degree of organization to be attained in studying pathogenic organisms in relation to the function or process of the host plant which they disturb. Now understand, I found myself in disagreement with easily four-fifths of this paper. From comments heard as the meeting broke up, I think I was not alone in this. But the important thing is that there was comment; and that in my case at least, there was a remaining fifth with which I did agree. My point is this; that the greatest value in these symposia lies in the opportunity to gather from the material presented an idea here and there which can be taken back and put to use at home. I discard almost categorically two premises: 1) that standardization of the introductory course is either possible or desirable, and 2) that any individual's course is such that it cannot continuously be improved by new suggestions from other sources. On this basis may I tell you what I think is good about my own course; you can easily decide for yourselves what is bad. And there may be notions which can be borrowed for use elsewhere.

One explanatory paragraph is necessary, i.e. you must know the particular circumstances under which my course is given. At Tennessee the bulk of students in agriculture must take a one-quarter course in plant pathology, usually in their junior year. They must do this even though they plan to specialize in other branches of the field. In view of the number who take jobs in education and extension, where all sorts of problems arise, this is probably a good thing. Bear in mind, however, that it is a required course, particularly for those in agronomy, horticulture, agricultural engineering, agricultural business, etc. As in all such situations, the enrollment tends to be high (some five hundred since January of 1948) and the morale low. The course is of some nine to eleven weeks, and as prerequisite the student need have only one quarter of elementary botany. Fortunately, more and more come to me with an additional term of general work, which includes the beginning treatment of genetics. We meet for two one-hour lecture sessions and two two-hour laboratory sessions (about twenty of each per term) weekly. These are rather different in objectives, and must be considered separately.

Lecture

Here I try to teach the student about plant disease (in the singular) rather than about plant diseases. No lectures are concerned with specific diseases as such. Each is, in so far as possible, a discrete unit. I am strongly of the opinion that in this course time is inadequate to cover in lecture both specific diseases and that material so inadequately described as the "principles" of plant pathology. Faced with such a choice, I have taken the latter.

In developing the lecture material, much of which was done jointly with my father in the few years immediately prior to his death, we have prepared manuscript for a text now in the hands of Dr. Verdoorn, of Chronica Botanica. Some of the chapter titles will give an indication of the contents:

Plants, plant disease, and human welfare
The host
The pathogen
Insects
Chemical Treatment
Market pathology
Handling plant disease problems
Etc.

Last year the book was used in mimeographed form; freeing some of the lecture time for more leisurely discussion of the material. By next year it will I hope be available in final illustrated form.

Laboratory

Laboratory time is almost exclusively devoted to study of specific diseases arranged with no great originality in sequence: viruses, bacteria, fungi, nematodes and flowering plants, physiogenic diseases. The level of presentation falls short, I am sure, of the standards outlined by Professor Whetzel some years ago. I suspect his students were a more carefully winnowed

group. I know that he was a more inspiring teacher. One or two emphases might be worthwhile.

In the first place, I have found the use of individually bottled or mounted specimens both convenient and helpful. These provide for one good specimen per desk (two students), largely undamaged from term to term, and are placed there in addition to material in open containers available for dissection. Needless to say, color fixation is an absolute must.

In my experience also, it is only fair to provide each student with an essentially complete set of microslides, if comparisons are to be encouraged.

Great emphasis is placed on Kodachrome slides, for only in this way can the actual appearance of diseased material be adequately shown. It is remarkable how many different sources, and subjects, will appear as one seeks to develop such material. Here are a few examples:

a) Commercial slides of diseased material, purchased from supply houses
b) Privately photographed material
c) Copies of borrowed slides *
d) "Previews" of experimental results; i.e. photographs showing results of experiments which class conducts in laboratory or greenhouse, usually taken during an earlier term
e) Photomicrographs in color of student microslides

No one thing seems to have aroused so much favorable comment on the part of students as the wholesale use of these slides, particularly those of the last group above.

Examinations

On this subject I should like to see the next symposium based, in case the committee needs a topic. It is, whether we like it or not, a very important part of the course from the students' and administration's viewpoint. My own examinations, like much of the rest of the course, and as my title implies, are regarded as "impractical". I am beginning to take pride in such an accusation. Let me cite an example or two of my favorite questions:

1) Eight elm trees have died on our campus in the last year and have been removed. What two diseases are most likely to blame? How would you try to find out which one is responsible?

2) The Plant Disease Reporter (33: 166. 1949) asks this question: "Will the unusually severe winter affect occurrence of plant diseases this year, and perhaps for some years to come?" Actually, they forget, perhaps, that some parts of the country had an unusually mild winter. But in any event, what would be your answer to their question, with appropriate reasons?

3) Newsweek, dated February 20, 1950, on page 49, under the section called "Science" has a few paragraphs about "Disappearing Oaks". According to them, a new oak wilt which started in Wisconsin in the 1930's has now reached seven States, and is moving rapidly. No oaks are known to be resistant to it, and they predict the possible occurrence of a destructive epidemic as severe as that which wiped out the chestnut years ago. Consider yourself a county agent whose attention is called to this article by some of your constituents. What would you consider the factors involved in the probable extension of this wilt into Tennessee? What would you tell your customer?

4) About three weeks ago Drew Pearson, in his syndicated column, wrote as follows; "Scientists working with the Atomic Energy Commission have been irradiating wheat rust and successfully changing the genetic pattern of the rust's growth. They have actually found a means, through the irradiation process, whereby the fungus attacks ragweed and other weeds, instead of attacking wheat." What gross fallacies do you see in Pearson's reasoning, based on

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*In response to a number of questions, the following comments on copying Kodachromes are appended. Almost any camera using 35 mm. film can be used (a single-lens reflex type such as the Kine Exakta is probably best.) See Stevens, R. B. and J. H. Taylor. "Photomicrography at your convenience" Science 108: 420-421. 1948). Provide first an even source of light from below, such as a photoflood or an inverted enlarger housing with the bellows and shutter removed. Then support over this light source, on an opaque frame such as heavy cardboard, the Kodachrome to be copied. With a little care, such a frame can be so designed as to make rapid shifting of slides possible. All that remains is to make a "close-up" shot of the slide by transmitted light, using Type-A Kodachrome in the camera. With the Kine Exakta, a 30 mm. extension tube gives almost exactly a 1:1 size reproduction. Readings of light intensity can be made by placing an exposure meter directly over the slide to be copied; and exposures for representative readings first standardized using black and white film. Once determined these exposures can be used with uniform success, even to the extent of improving upon faulty exposures in the original.

your knowledge in the field of pathology?

5) The following is from a description of the work of the University of Maryland, and was published in Science in September 10, 1948: "A day does not go by that a new development is not announced that will make the life of Maryland's thousands of farmers either easier or more profitable". In view of our remarks concerning the expense and uncertainty of research in science, please comment on the above.

To my notion, nothing is more practical than this sort of question; the real disadvantage is the very much greater effort involved in grading such exams as compared with the highly popular "objective" type. These always ought to be, and frequently are, given as "open book" examinations. This will arouse some comment from students but, is I think, basically sound.

At this point I should like to claim that pressure of time makes it impossible to continue with a number of additional suggestions. But frankly, that is all I have. If the course has any "special features", they are:

1) Devotion of the entire lecture portion to "principles" of plant pathology, supported by a new text which considers only this material and utilizes specific diseases only as illustrative material. This is accompanied by an effort to make each lecture (i.e. each chapter) an essentially complete unit in itself.

2) Use of individual mounted or bottled specimens, individual sets of slides, and abundant Kodachromes in the laboratory treatment of representative diseases; this in turn enlivened by experimental work in the greenhouse.

3) Examinations given as "open book" tests; questions designed to suggest some of the problems commonly encountered from day to day. There is, of course, a practical examination in the laboratory.

I must not close without making a final, and most valuable of all, suggestion. Specifically, the teachers of plant pathology will do well to enlist the aid of their non-teaching colleagues. For most of the ideas I consider good, and for much of the material essential to such a course, I am deeply indebted to a number of them. If any are present tonight I want to recognize their help and thank them for it.

BOTANY DEPARTMENT, UNIVERSITY OF TENNESSEE, KNOXVILLE

STANDARDIZING A GENERAL COURSE IN PLANT PATHOLOGY

Stephen Diachun

On the surface of things it would seem that certain principles and facts should be taught in every beginning course in plant pathology -- that is, some standardization appears to be natural, inevitable, and maybe desirable; desirable because, in the first place, a standardized guide or set of universally acceptable objectives, principles, facts, exercises, and questions would make teaching easier in the beginning course, especially for young, inexperienced beginning teachers. This point is self evident. A teacher in doubt as to what to teach or how to teach could refer to the standard. That should reduce mental torment, uncertainty, and sweat; but mental sweat is part of the fun of teaching, and if too much of it is cut out teaching can become mere drudgery.

In the second place, a standardized beginning course might be desirable because it would make graduate teaching in plant pathology easier, inasmuch as all graduate students would have a common background, training, and experience on which to build. I do not have enough experience teaching graduate students to know whether that would actually be desirable, but I have some doubts. I do know that when I was a graduate student some of my stimulation and education resulted precisely from the fact that my fellow students had diversified backgrounds, training, and experience.

In the third place, if teachers could agree on what every student should know about plant pathology, and the beginning course could thus be standardized, then it would be possible to devise comprehensive final examinations, provided the teachers could agree on what kind of examinations to give. Such examinations might be useful in measuring the effectiveness of teaching as well as learning.

On the other hand, a positive case can be made for keeping the beginning course unstandardized. In the first place, with regard to content or subject matter, opportunity and time should be allowed for diversity. In my opinion, one of the objectives of a beginning course in plant pathology is to give students a chance to get a glimpse of the ways in which progress is made in understanding and controlling plant diseases, and to at least begin to realize that the correct answer to many questions is yet unknown; that truth is elusive; that progress toward truth is slow, faltering, difficult, and costly; that progress in practical agriculture often is dependent on fundamental biological research which is especially slow and expensive. These concepts or these attitudes can be taught most effectively when the teacher is teaching the things he knows best, which of necessity lie in a relatively small segment of the whole field. I think that my own teaching is best when I deal with problems and diseases with which I've had most experience, and I think the students agree with me. A teacher often can select vivid incidents from his own experience to lead into generalizations or principles, and should do so. In my opinion, Dr. Stakman, for instance, should dwell on rusts and physiological specialization; Dr. Riker should take extra time with crown gall and bacterial diseases; Dr. Valleau should emphasize virus diseases and control of tobacco diseases by breeding. Otherwise, if these teachers lean over backwards to refrain from concentrating on their specialties, the students may actually be deprived of lively contacts with experts at their best. There is an obvious danger, namely, that teachers burden students with details of their own personal research and interests at the sacrifice of a broad, well rounded course; but with much effort this danger can be minimized.

In the second place, with regard to methods of teaching, consideration must be given to the fact that teachers are individuals with personalities. Different teachers have different skills and abilities. Even though the lecture method is being condemned in many places, and perhaps rightly so in many cases, still, lecturing, especially by skillful and eloquent speakers, can be an effective way of teaching. Every teacher does not have, and maybe cannot acquire, the ability to draw out students to participate in general discussions; nor can the so-called "problem solving" method be used successfully by all teachers. Some teachers prefer lecture-demonstrations, whereas others are firm believers in laboratory study. I am becoming one of the latter. At one time I was seriously considering eliminating laboratory periods and using demonstrations instead -- frankly, because I thought it would be cheaper and easier -- but after questioning students and observing their reactions to demonstrations and laboratory work I decided to continue laboratory exercises. When I asked students to evaluate the usefulness to them of lectures, class discussions, demonstrations, laboratory study, text assignments, and reading of original research papers, the laboratory work was rated at the top almost unanimously.

In my experience, students respond better to laboratory study in which they actually participate than to demonstrations. For example, in a laboratory exercise on viruses, students working in small groups inoculated tobacco mosaic virus from several sources, including

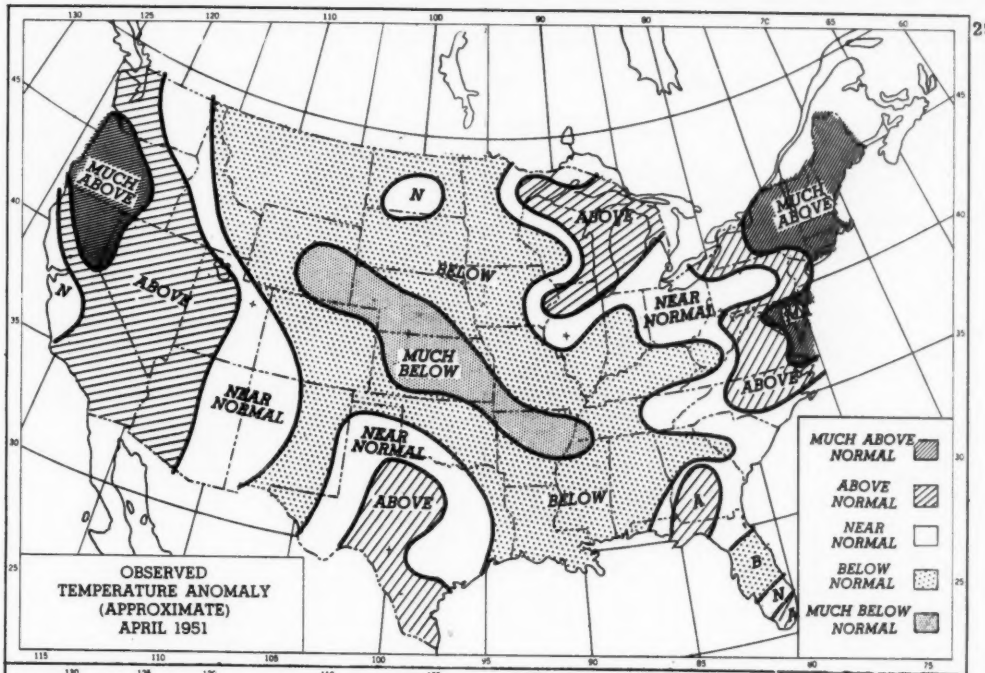
naturally infected plantains growing just outside the laboratory, onto several hosts -- tobacco, tomatoes, and Nicotiana glutinosa. In addition, I had a "demonstration" -- tobacco plants inoculated with streak virus with inoculum prepared and treated in several ways (with and without buffer, with and without carborundum, and with and without healthy juice added). The plants were by chance so placed in the greenhouse that the "demonstration" was much more easily accessible for observation. At the next laboratory meeting I noticed that the students had stumbled over and around the ignored demonstration on their way to look at their own tests. Maybe there is a moral: Capitalism works best even in plant pathology teaching.

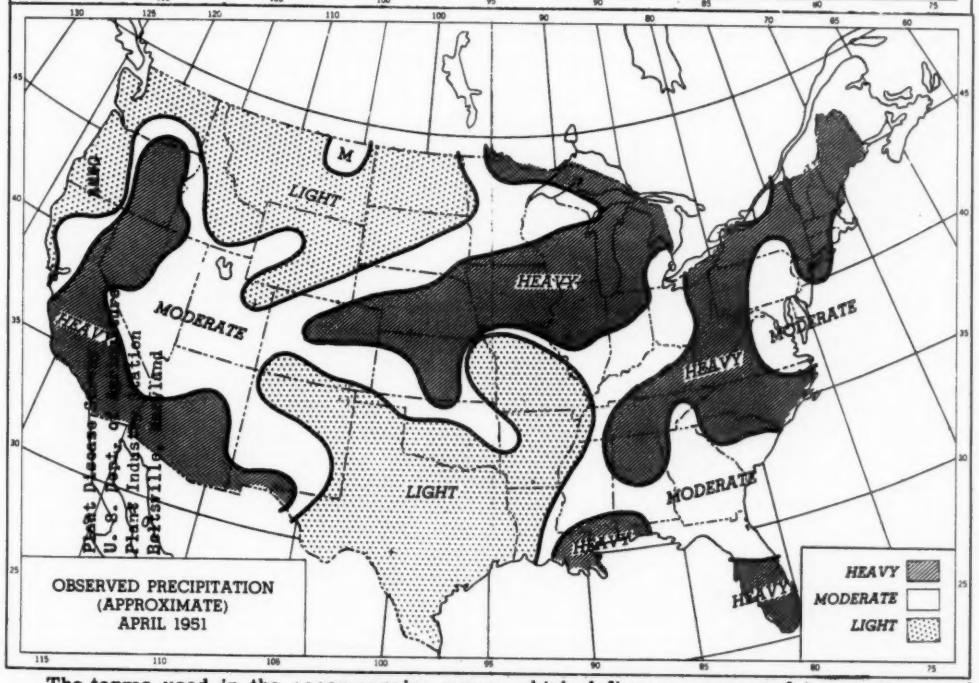
Obviously the available facilities, such as laboratory space, greenhouse space, equipment, disease plots, and student assistance vary from one institution to another. Each teacher should be able to take advantage of the best facilities to adapt to his own abilities.

Still a third difficulty in the way of standardizing a beginning course is that the needs of the students are not standardized. Plant pathology is a hybrid of sorts between basic and applied science. Most students in most beginning courses are not going to become plant pathologists or professional scientists of any kind; rather many of them, at least those in agricultural areas, will be county agents, high school teachers, soil conservation technologists and advisers, business men, a few farmers, and a few scientists. These students are especially interested in local and regional problems. It does not seem advisable to neglect this local interest. In my experience students are most interested in diseases with which they have some contact. In Kentucky, a beginning course in plant pathology without some emphasis on tobacco diseases would be, I am afraid, a failure, whereas in Kansas or Washington such emphasis would be pointless.

And so, in spite of our natural desire to build a standardized course, and in spite of advantages of such a course, it would be well to proceed with caution. Objectives in a beginning course have not completely crystallized. There is yet no one best way of teaching; various ways are being used, both successfully and unsuccessfully; new ways are being tried. Facilities are different. Specific problems are different. Student needs are different. This seems to point to need for continued diversity rather than very much standardization. All this should not keep us from exchanging opinions about the best ways to achieve our common objective, namely, good teaching.

UNIVERSITY OF KENTUCKY, LEXINGTON





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.